US011796190B2

(12) United States Patent
Oh et al.

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(45) Date of Patent: Oct. 24, 2023

(54) **AIR MANAGEMENT APPARATUS OR DEVICE**

(71) Applicant: **LG ELECTRONICS INC.**, Seoul (KR)

(72) Inventors: **Min Kyu Oh**, Seoul (KR); **Yong Nam Kim**, Seoul (KR); **Yang Hwan No**, Seoul (KR)

(73) Assignee: **LG ELECTRONICS INC.**, Seoul (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 277 days.

(21) Appl. No.: **17/072,953**

(22) Filed: **Oct. 16, 2020**

(65) **Prior Publication Data**

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(30) **Foreign Application Priority Data**

Dec. 10, 2019 (KR) 10-2019-0163424
Dec. 10, 2019 (KR) 10-2019-0163426
(Continued)

(51) **Int. Cl.**
F24F 1/0033 (2019.01)
F24F 1/0014 (2019.01)
(Continued)

(52) **U.S. Cl.**
CPC ***F24F 1/0033*** (2013.01); ***F24F 1/005*** (2019.02); ***F24F 1/0011*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC .. F24F 1/0011; F24F 2013/205; F24F 1/0014; F24F 2221/36
See application file for complete search history.

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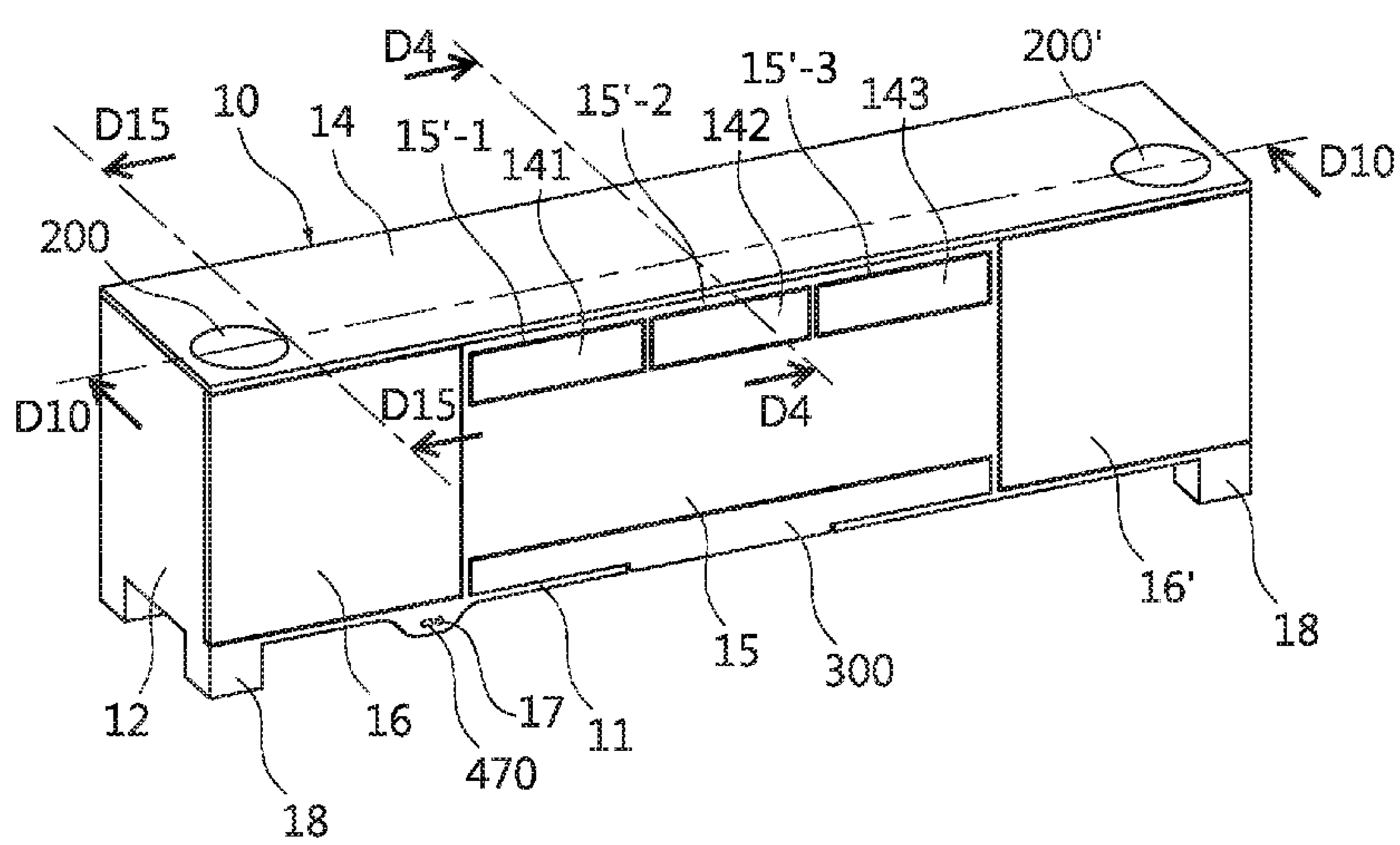
Primary Examiner — Schyler S Sanks
(74) *Attorney, Agent, or Firm* — KED & ASSOCIATES, LLP

(57) **ABSTRACT**

An air management device may include three independently operated primary impellers **131**, **131'**, **131"**, and drawn-in air is discharged through discharge ports **15'-1**, **15'-2**, **15'-3** provided in the front plate **15** of the housing **10**. Louvers **141**, **142**, **143** installed downstream of the air flow and discharge ports **15'-1**, **15'-2**, **15'-3** may be independently opened or closed to provide discharge of the air to the surrounding environment. Further, at least one retractable or pop-up fan may be provided. The air management allows customization of air flow. The housing **10** of the furniture-type air management device may be installed on the floor of the livable space and may have a hexahedron shape that extends from side to side. A bottom inlet **11'** may be formed on the bottom plate **11** of the housing **10** facing the floor of the living space above a predetermined distance. The replaceable filter **300** may be installed to filter the air sucked through the bottom inlet **11'**, and may be drawn in and out of the housing **10**. A plurality of passage openings **302** may be formed in a filter frame **301**, and filters **320**, **330**, and **340** are stacked over the passage openings **302**.

7 Claims, 51 Drawing Sheets



(30) **Foreign Application Priority Data**

Dec. 10, 2019	(KR)	10-2019-0163428
Dec. 10, 2019	(KR)	10-2019-0163430
Dec. 10, 2019	(KR)	10-2019-0163431
Dec. 10, 2019	(KR)	10-2019-0163432
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Dec. 10, 2019	(KR)	10-2019-0163441
Dec. 10, 2019	(KR)	10-2019-0163444
Dec. 17, 2019	(KR)	10-2019-0168728

(51) **Int. Cl.**

F24F 13/14	(2006.01)
F24F 13/20	(2006.01)
F24F 13/02	(2006.01)
F24F 1/0073	(2019.01)
F24F 1/035	(2019.01)
F24F 13/08	(2006.01)
F24F 1/0087	(2019.01)
F24F 1/005	(2019.01)
F24F 1/0063	(2019.01)
F24F 13/28	(2006.01)
F24F 13/30	(2006.01)
F24F 1/0011	(2019.01)
F24F 1/0029	(2019.01)
F24F 13/06	(2006.01)
F24F 13/32	(2006.01)
F24F 3/00	(2006.01)
F24F 6/00	(2006.01)

(52) **U.S. Cl.**

CPC ***F24F 1/0014*** (2013.01); ***F24F 1/0029*** (2013.01); ***F24F 1/0063*** (2019.02); ***F24F 1/0073*** (2019.02); ***F24F 1/0087*** (2019.02); ***F24F 1/035*** (2019.02); ***F24F 13/0236*** (2013.01); ***F24F 13/06*** (2013.01); ***F24F 13/085*** (2013.01); ***F24F 13/14*** (2013.01); ***F24F 13/20*** (2013.01); ***F24F 13/28*** (2013.01); ***F24F 13/30*** (2013.01); ***F24F 13/32*** (2013.01); *F24F 2003/008* (2013.01); *F24F 2006/008* (2013.01); *F24F 2013/205* (2013.01); *F24F 2221/36* (2013.01)

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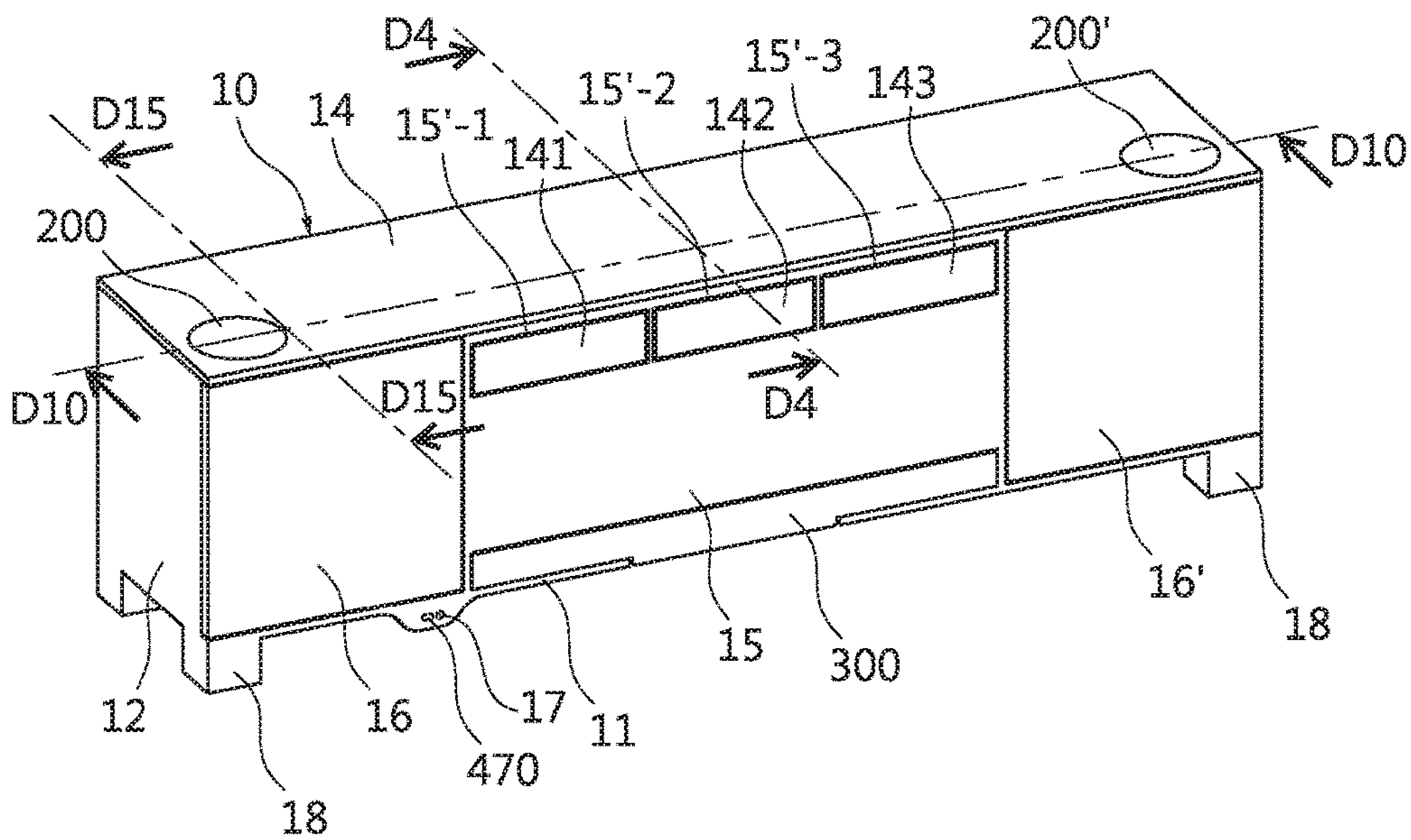
FIGURE 1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10
14
15'-1
141
15'-2
142
15'-3
143
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D10
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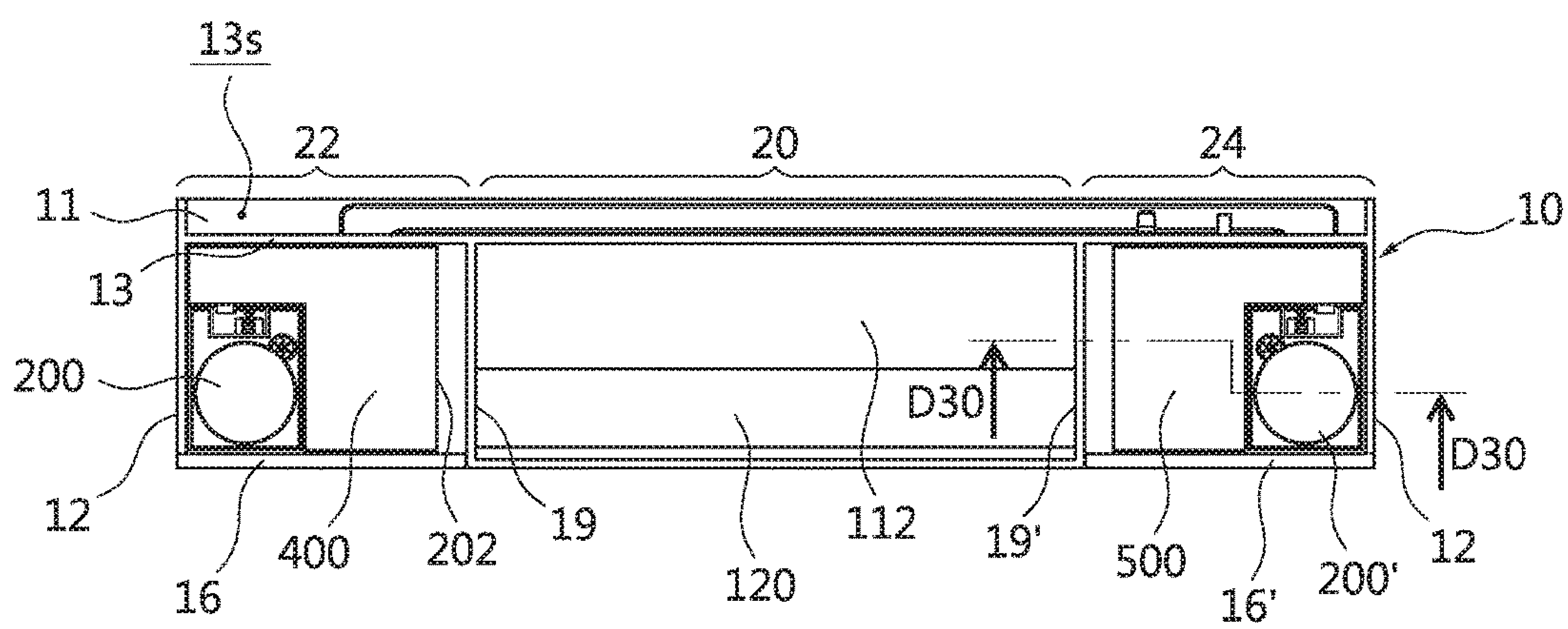
D10
D15
D4
12
16
470
17
11
15
300
16'
18
18

FIGURE 2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20
24
11
10
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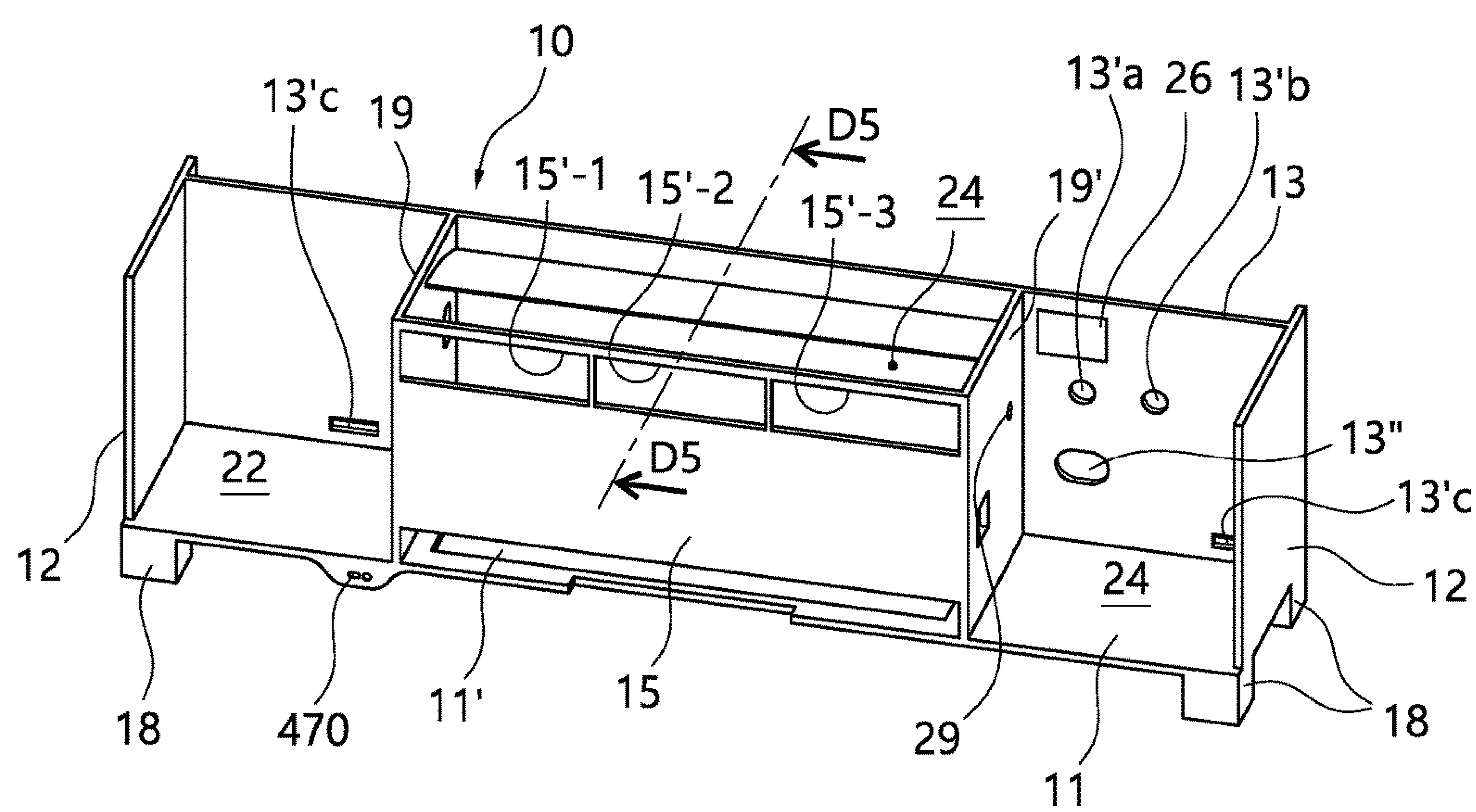
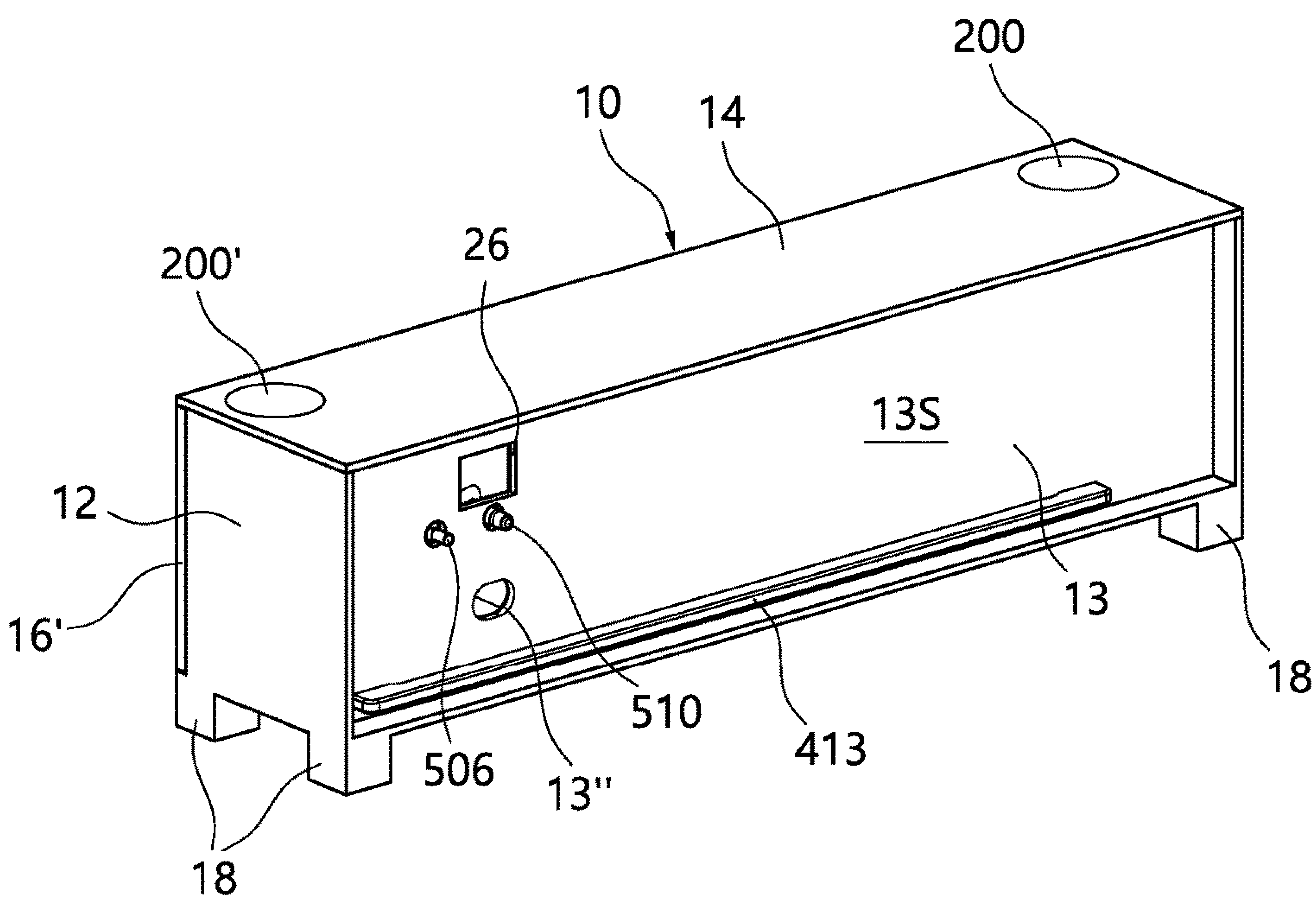
500
16'
200'
12

FIGURE 3A



10
13'c
19
15'-1
15'-2
D5
15'-3
24
19'
13'a
26
13'b
13
13"
13'c
22
D5
12
24
12
18
470
11'
15
29
11
18

FIGURE 3B



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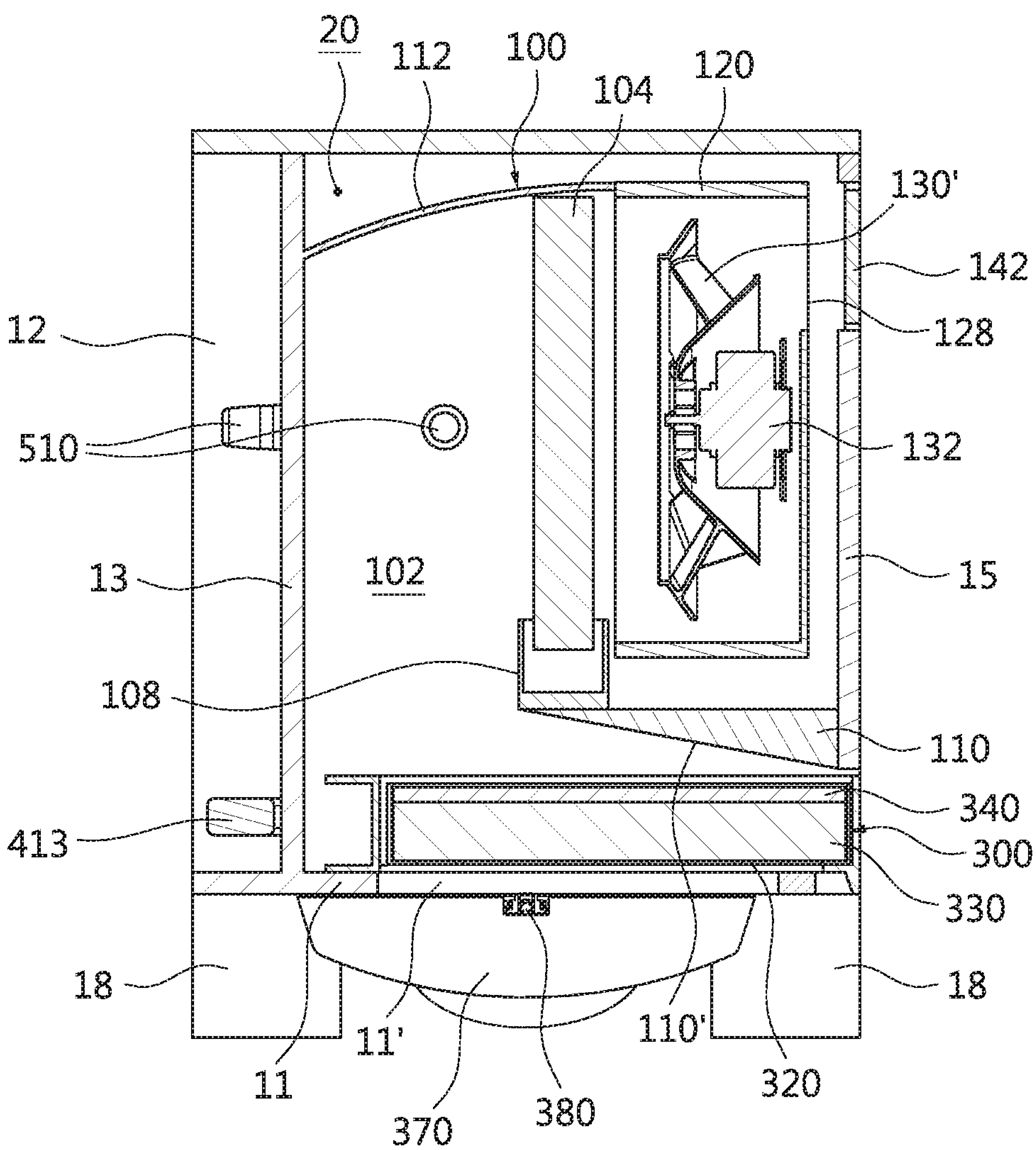
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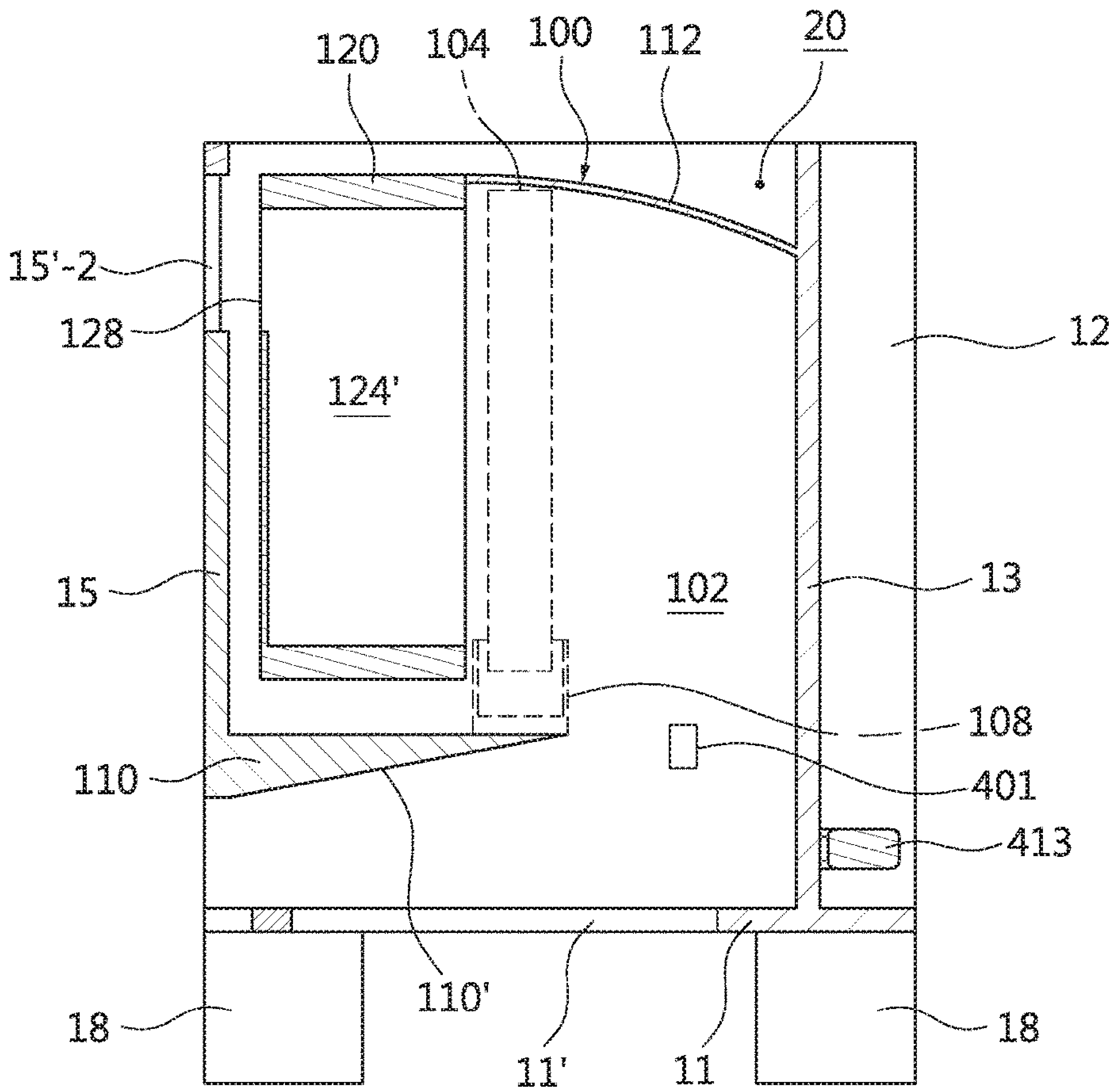
100
104
120
130'
142
12
128
510
132
13
102
15
108
110
340
413
300
330
18
18
11'
110'
11
320
370
380

FIGURE 5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104
100
112
20
15'-2
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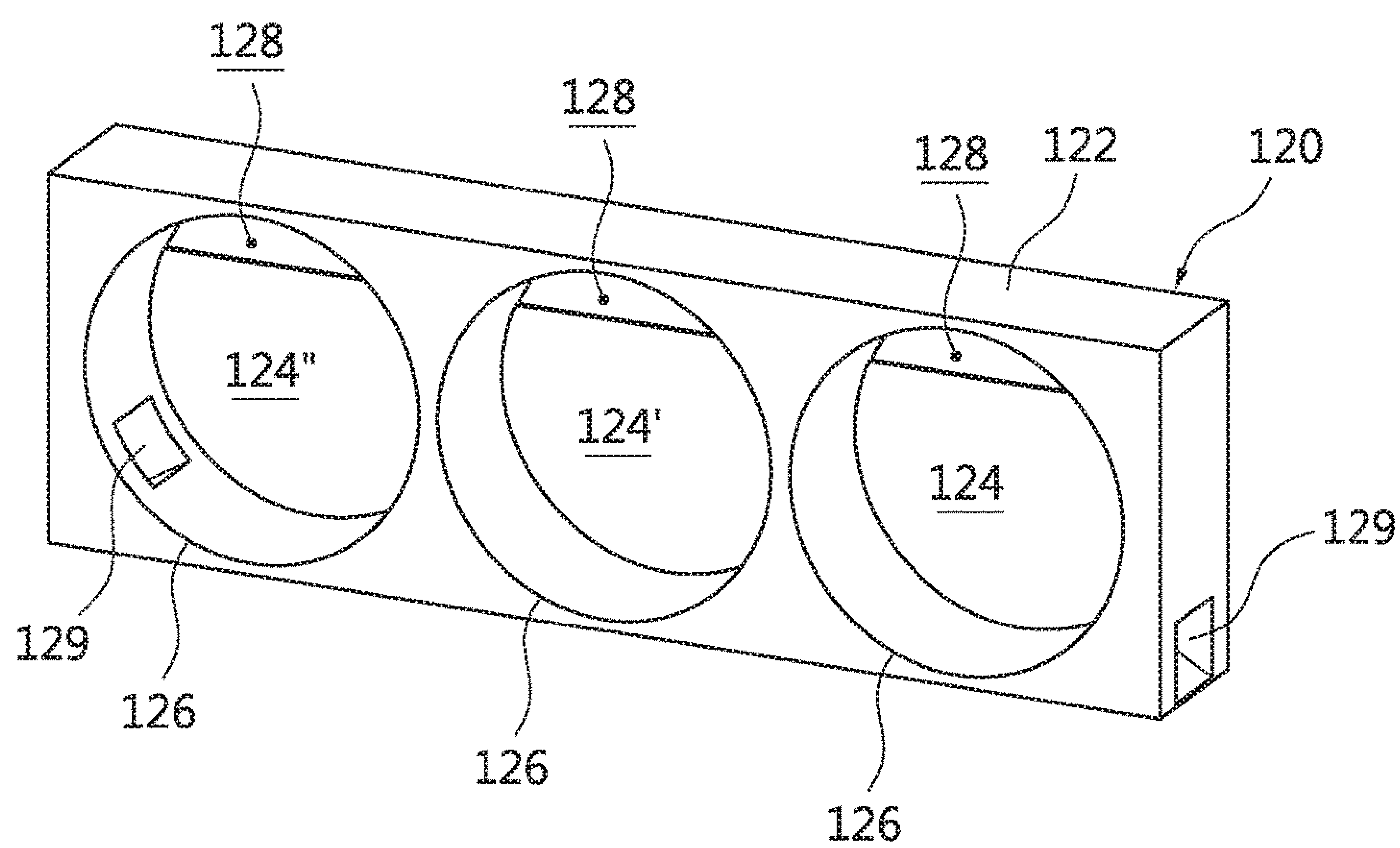
124'
12
15
102
13
108
110
401
413
110'
18
11'
11
18

FIGURE 6



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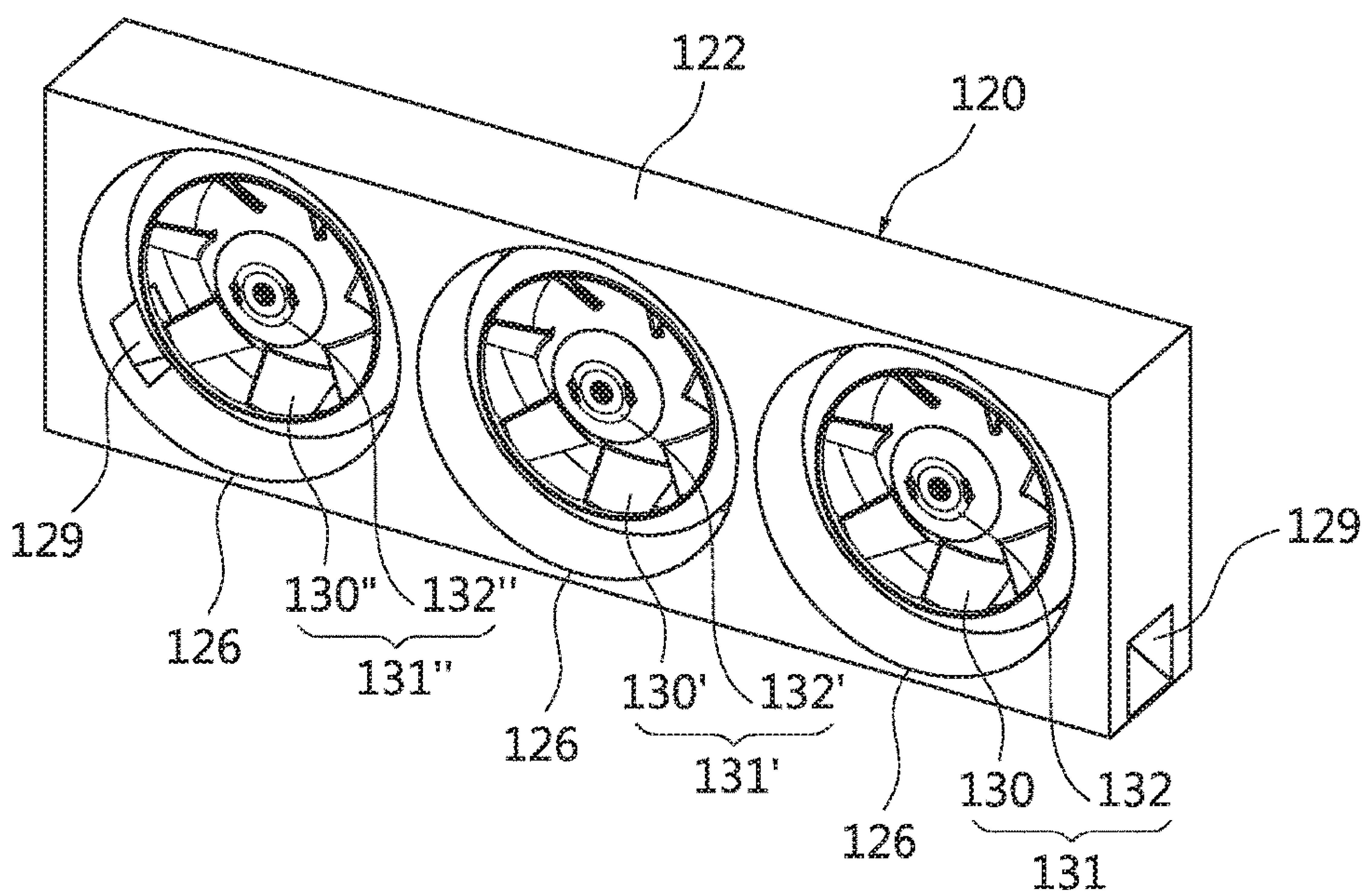

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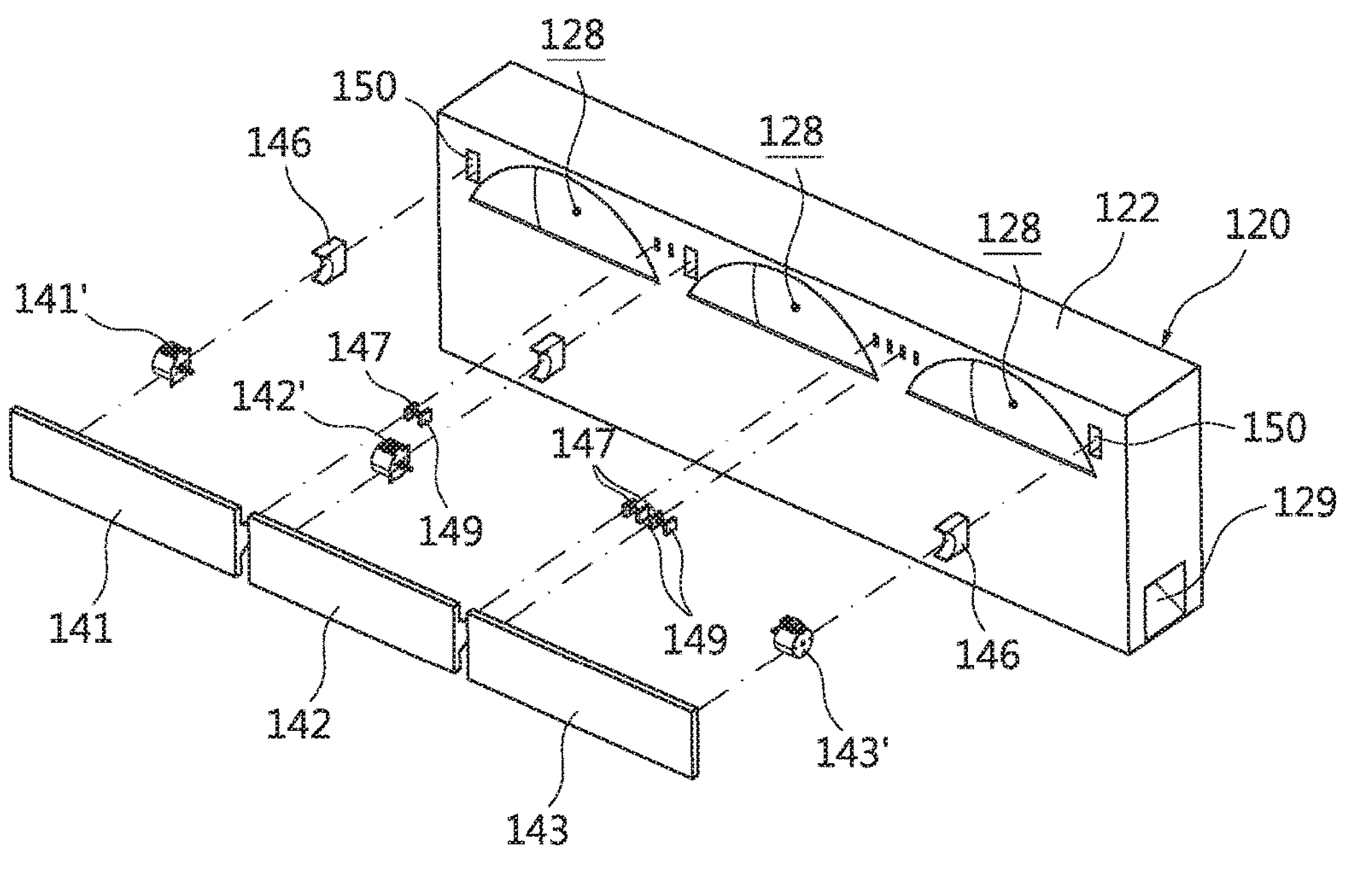
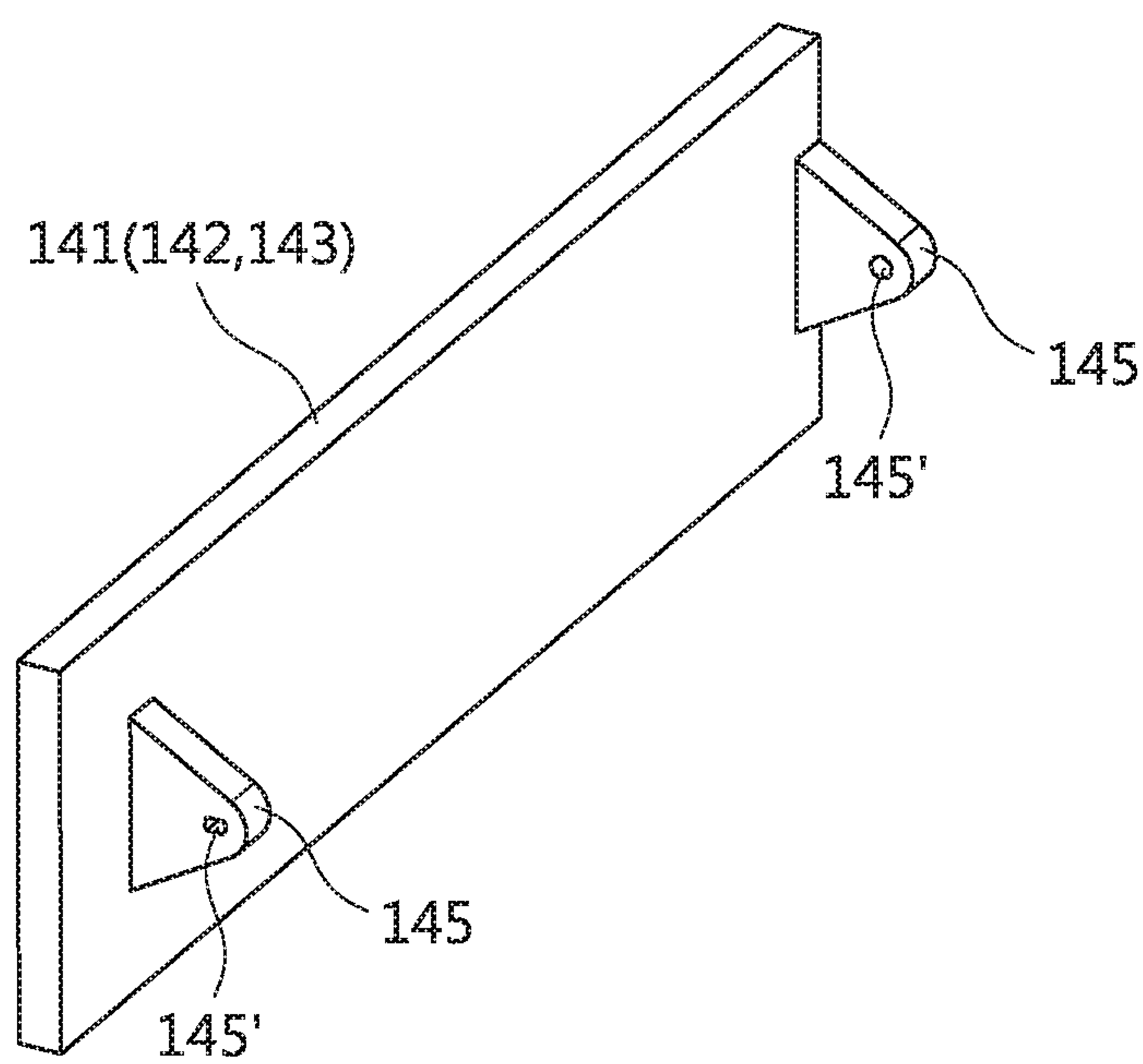


128
150
128
146
128
122
120
141'
147
142'
150
147
149
129
141
149
146
142
143'
143

FIGURE 9



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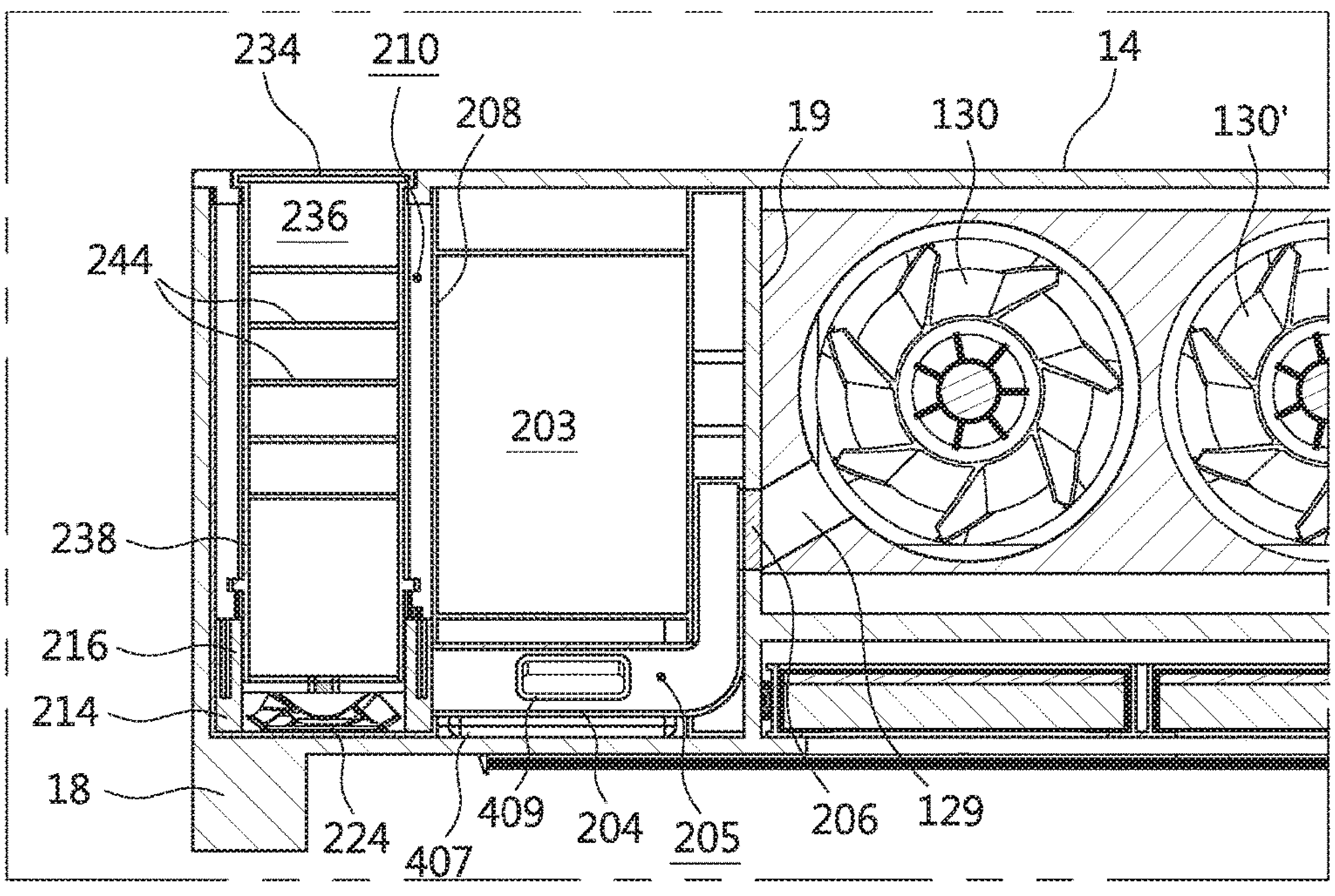
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130'
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244
203
238
216
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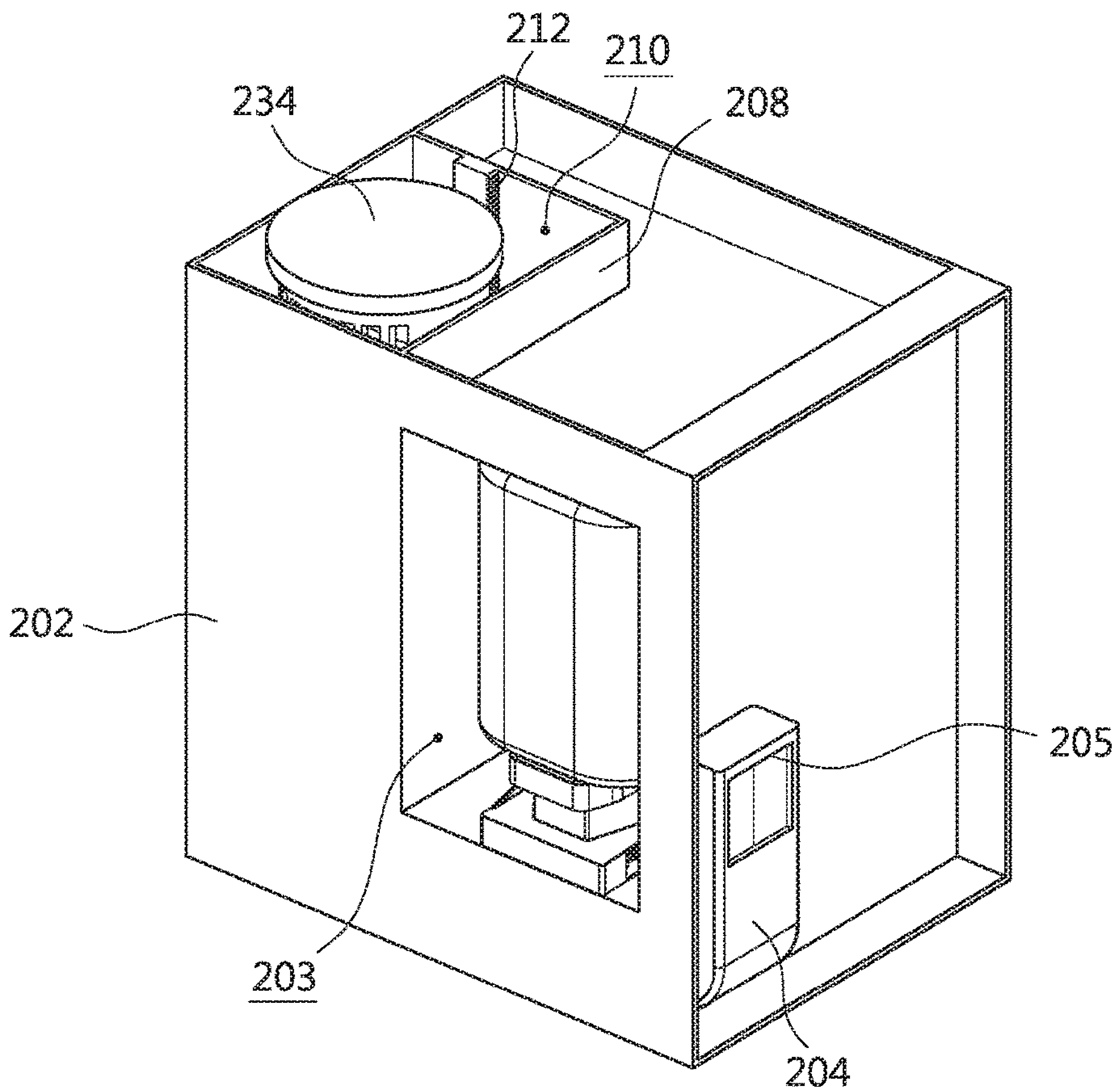
224
407
409
204
205
206
129

FIGURE 11



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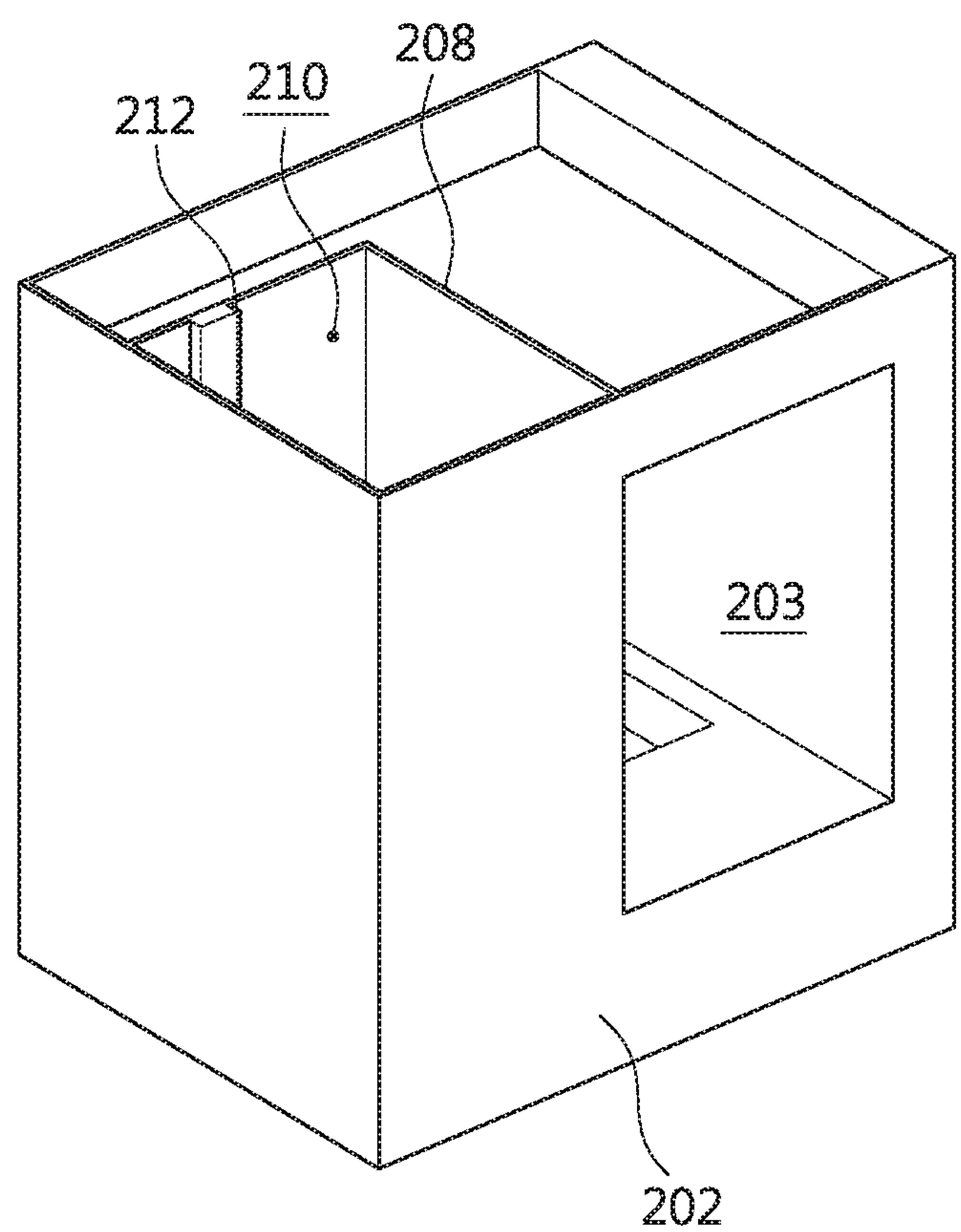

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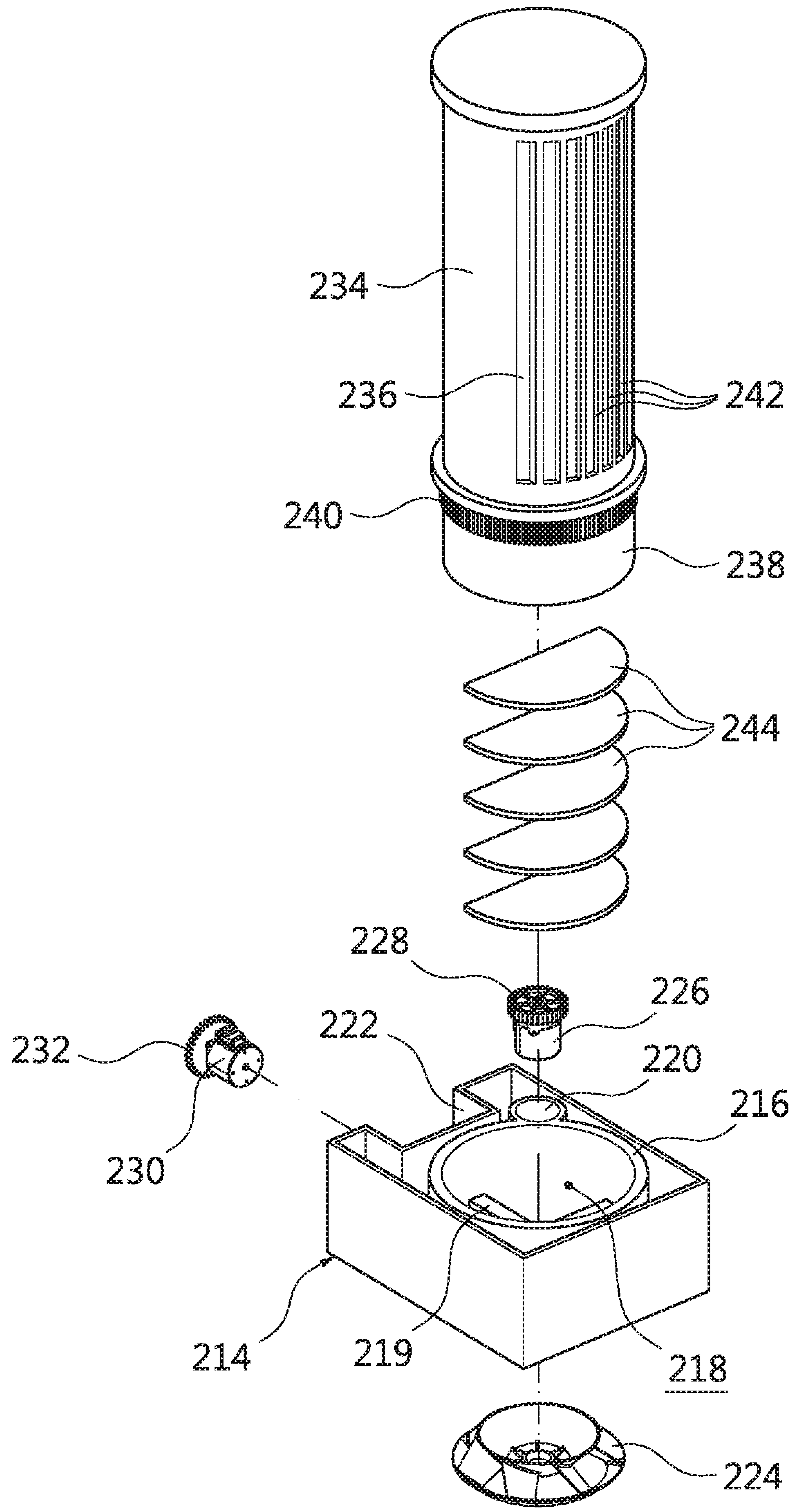
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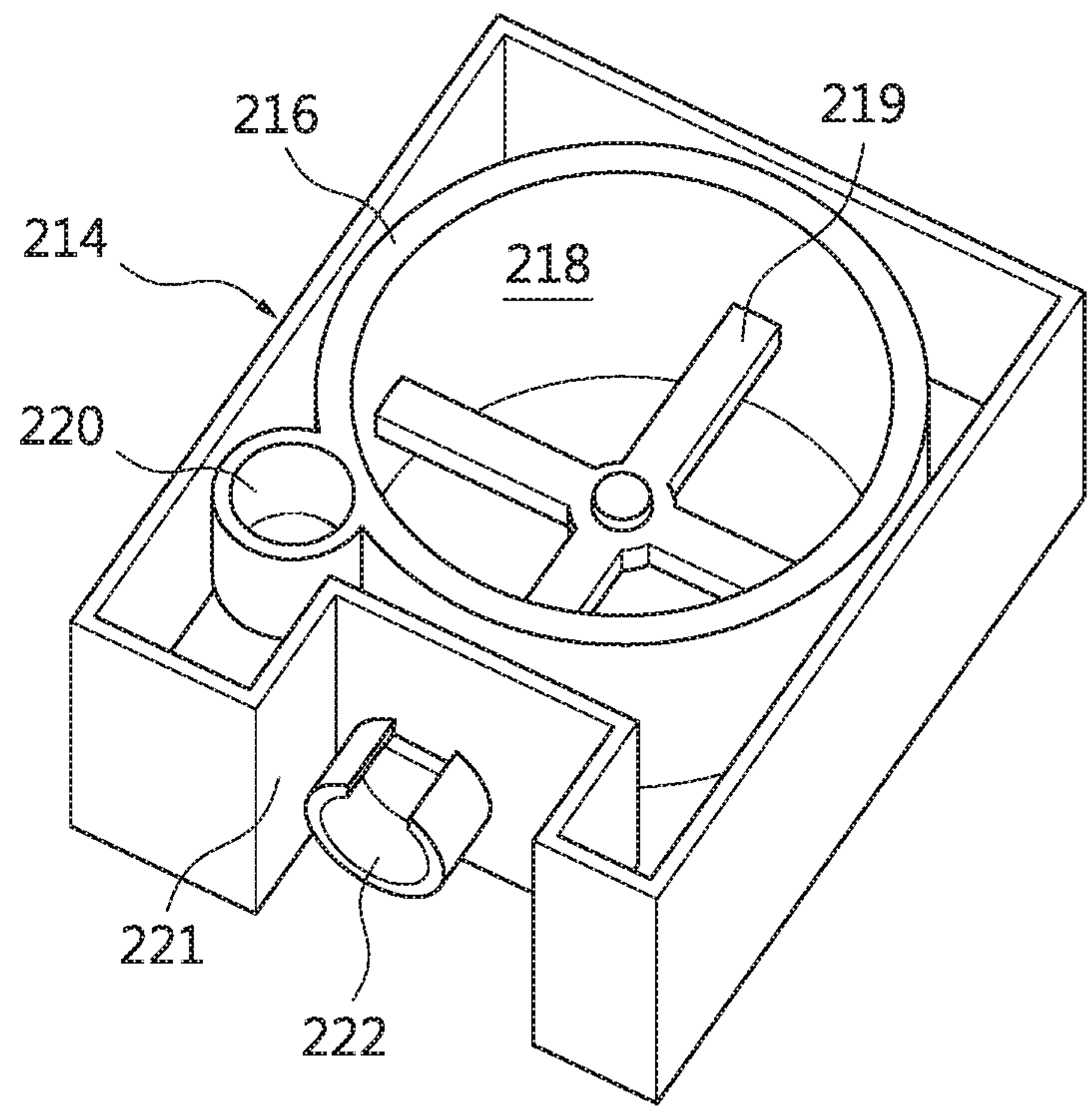

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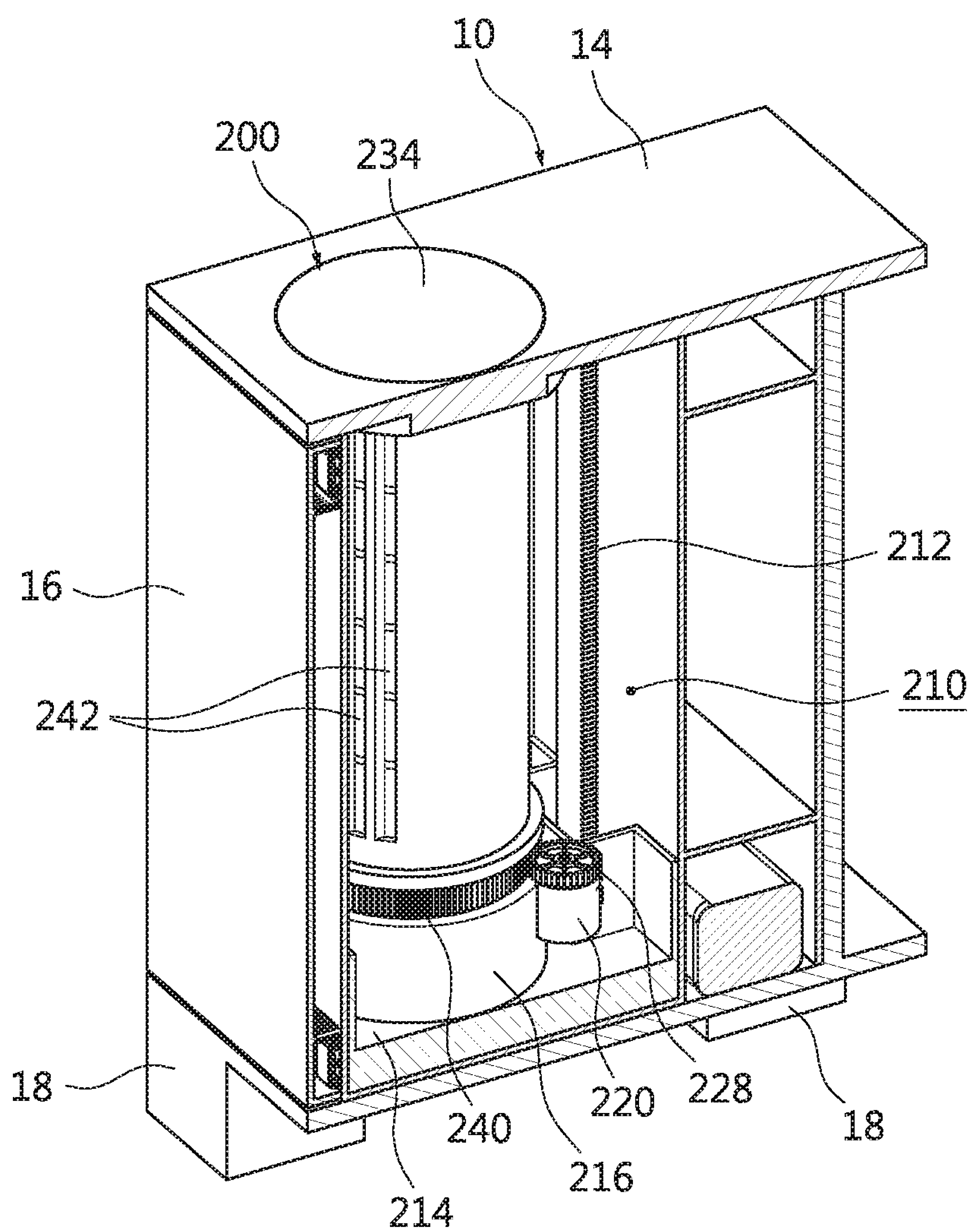

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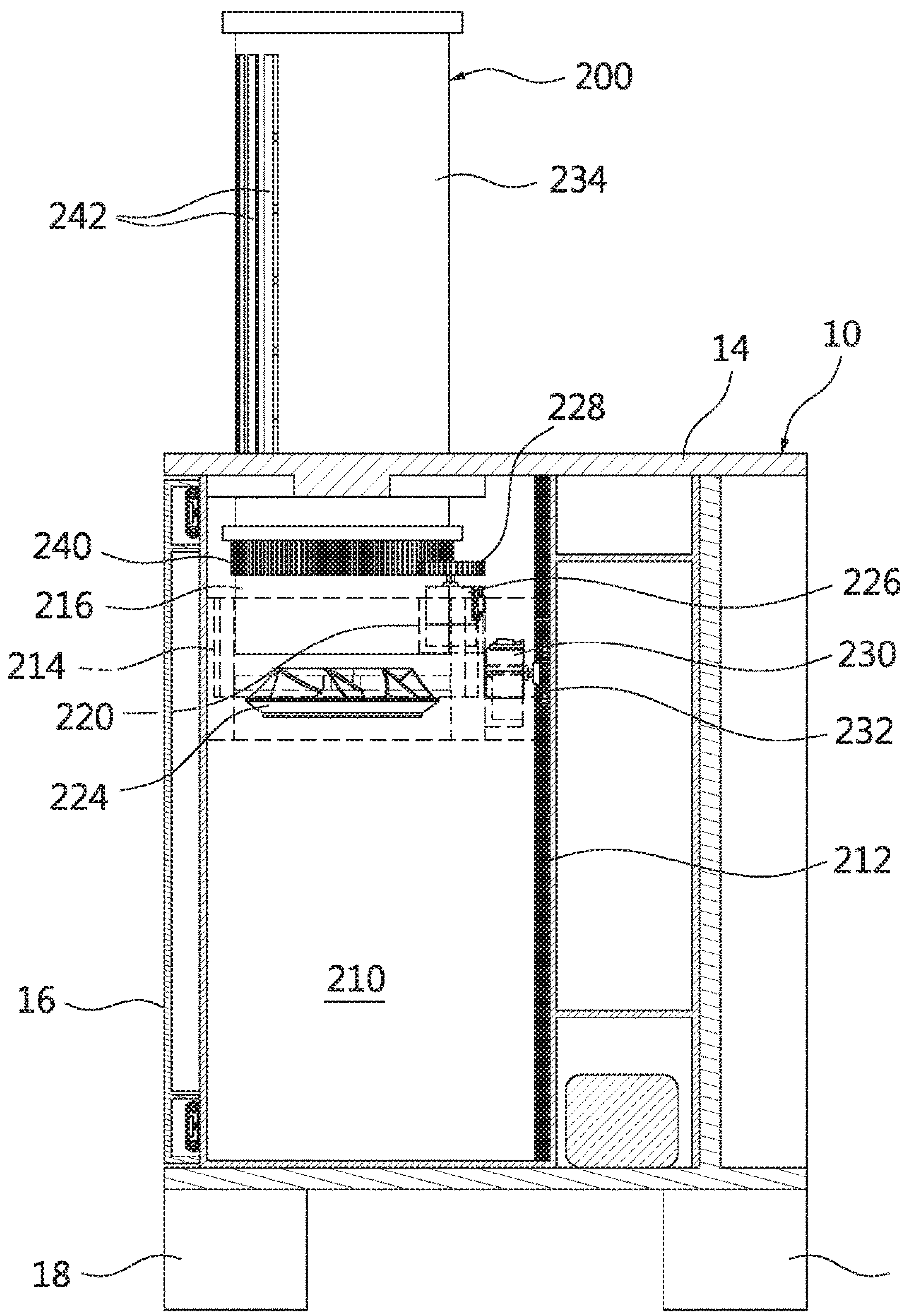
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234
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14
10
228
240
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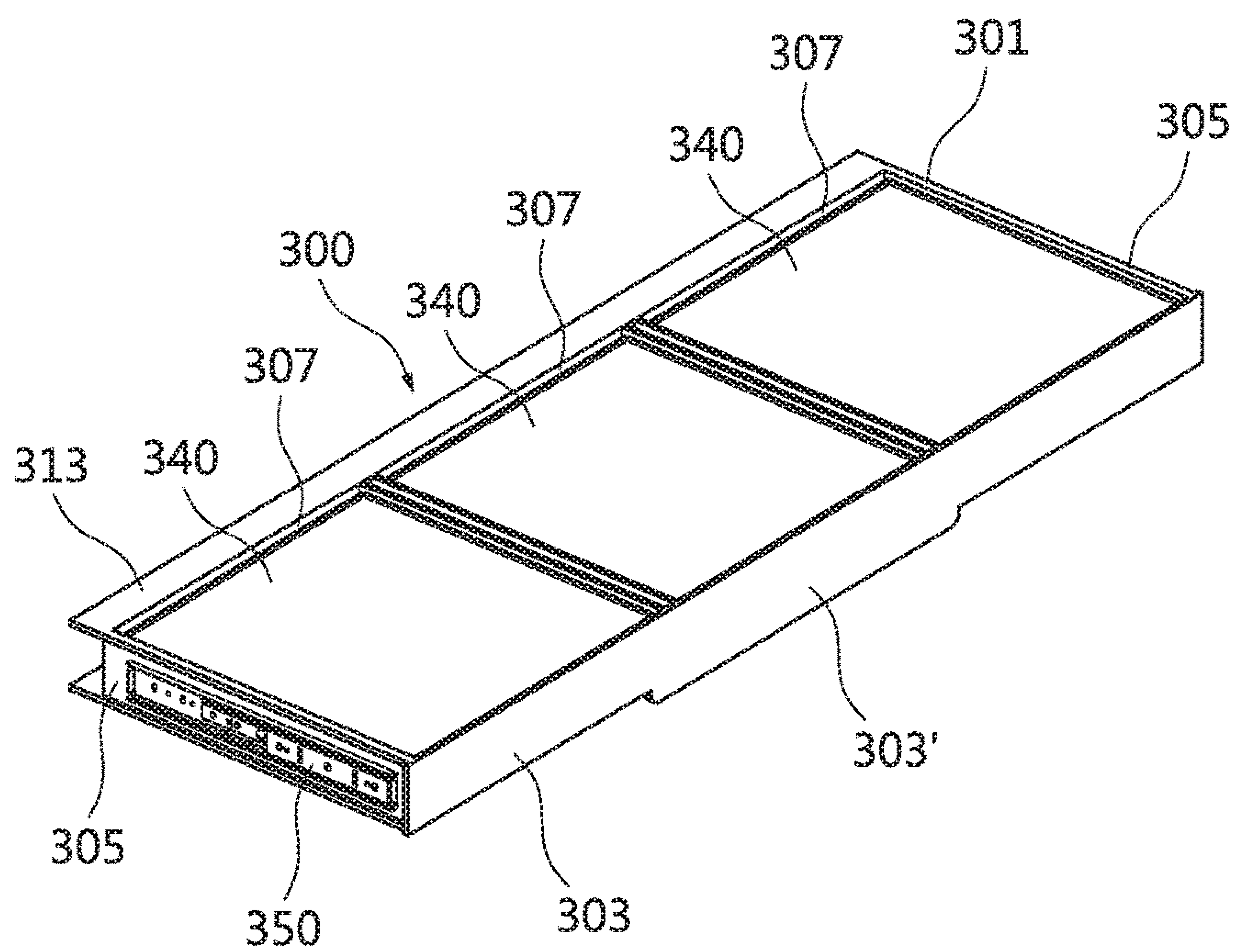
214
230
220
232
224
212
210
16
18
18

FIGURE 17



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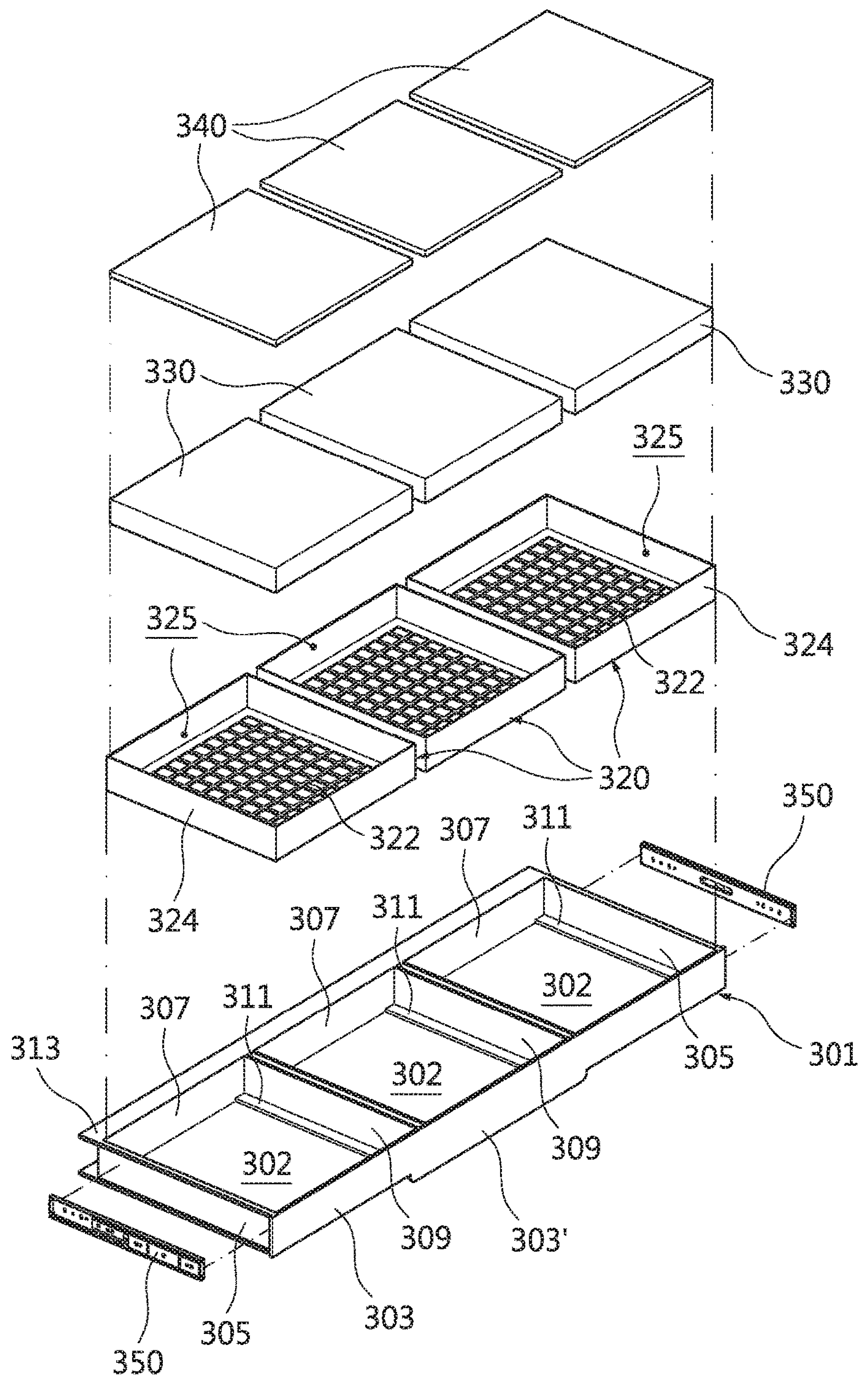

340
330
330
325
325
324
322
320
322
324
350
307
311
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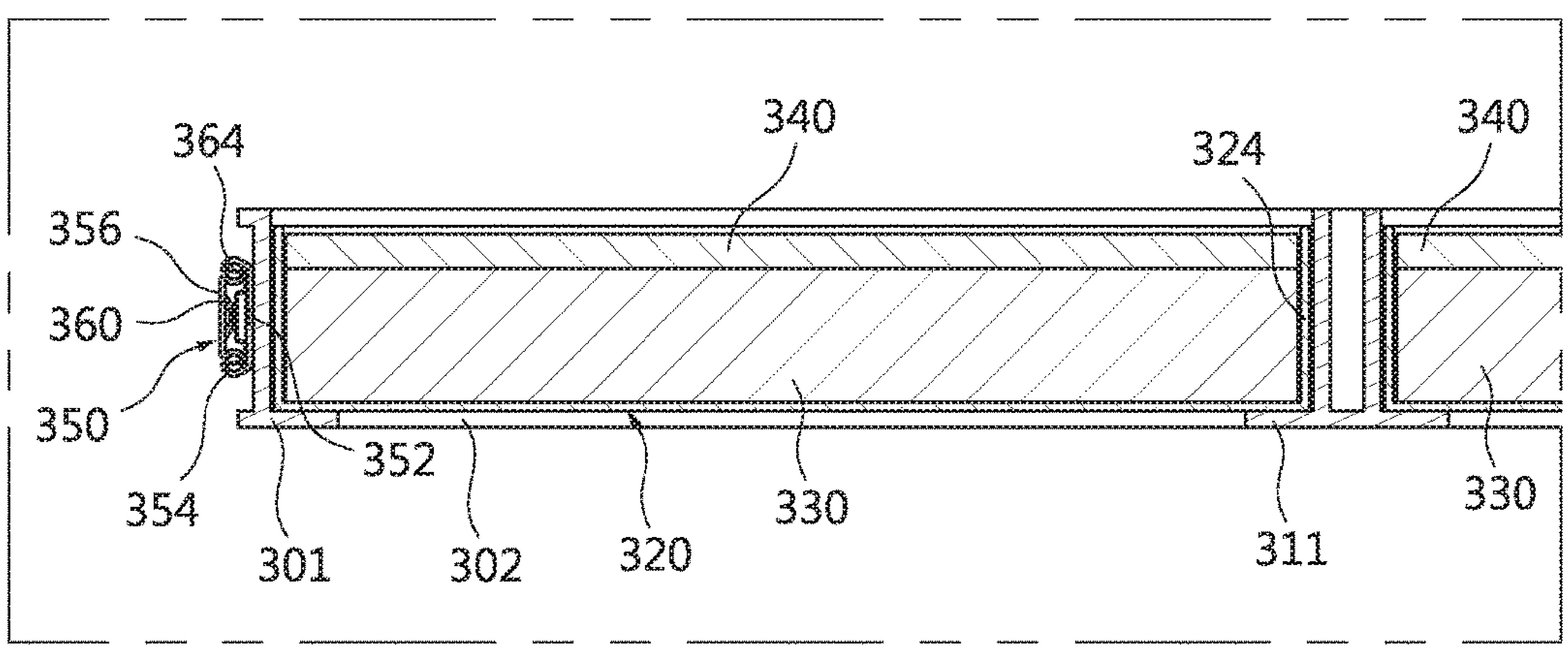
307
311
302
302
302
313
305
301
309
309
303'
303
305
350

FIGURE 19



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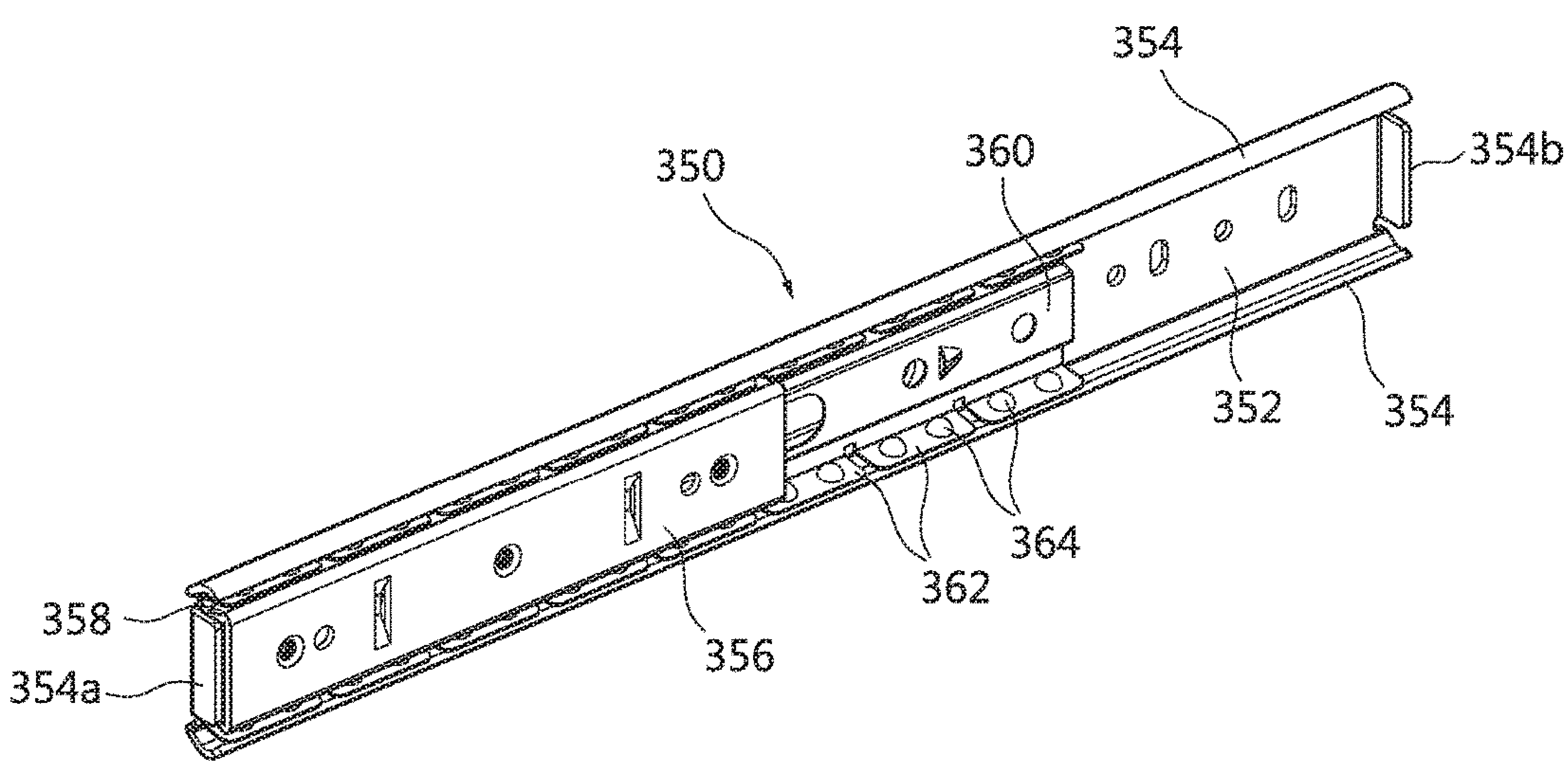

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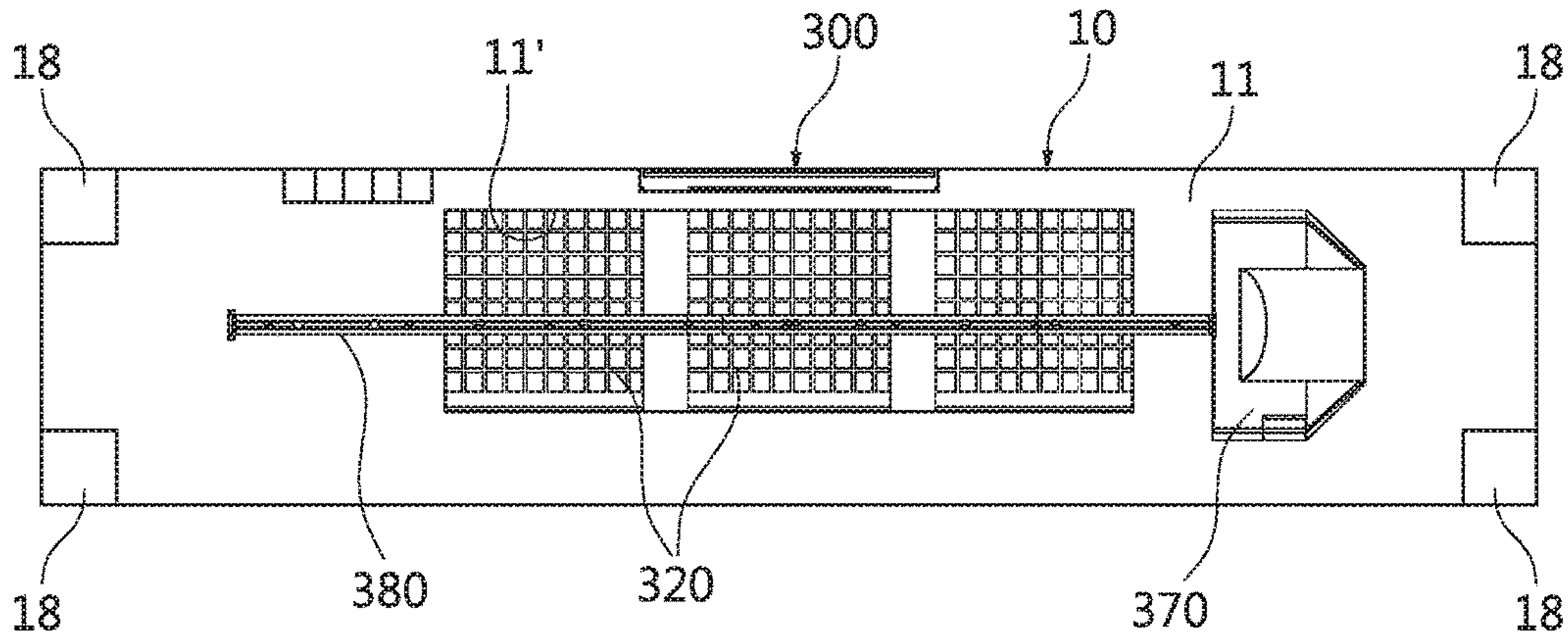

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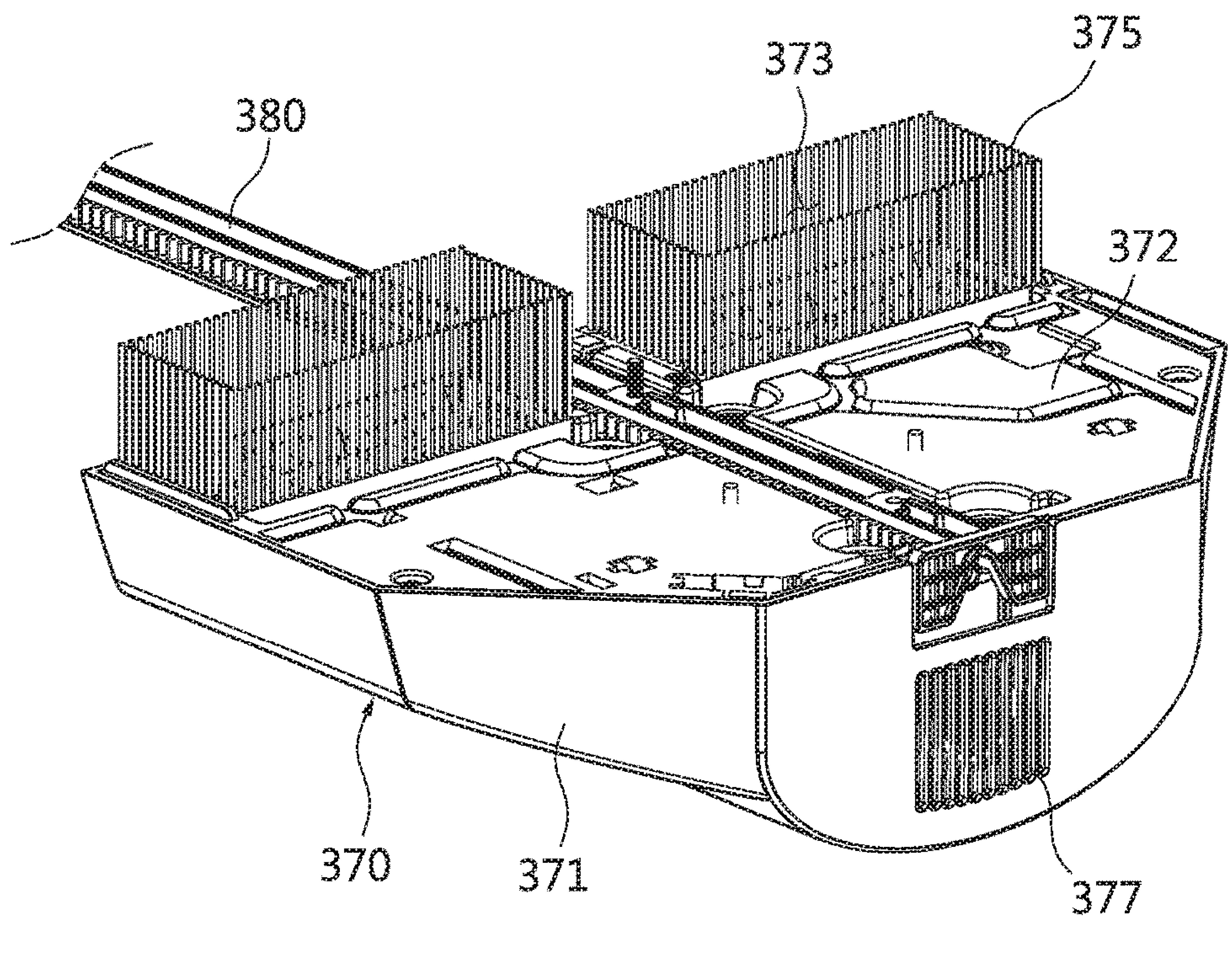


FIGURE 23

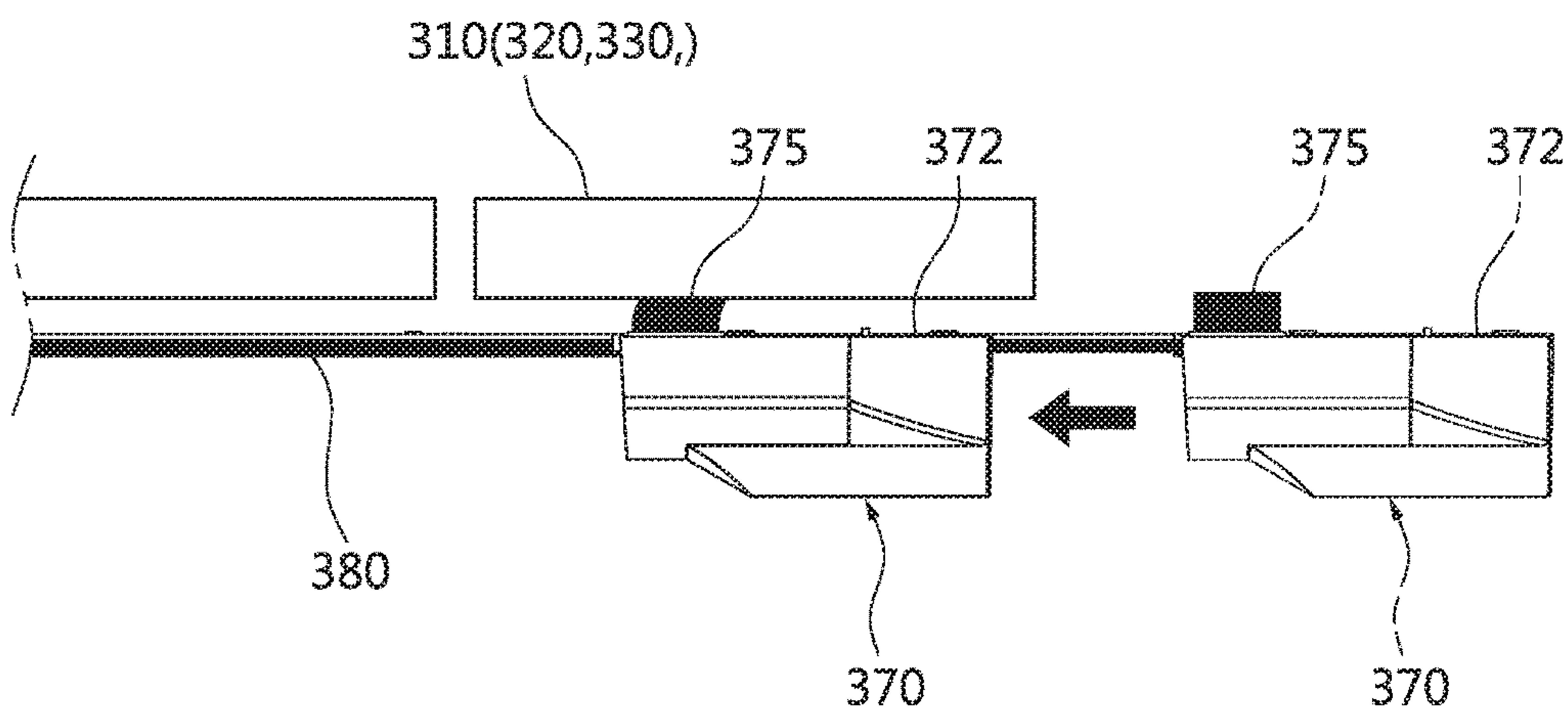
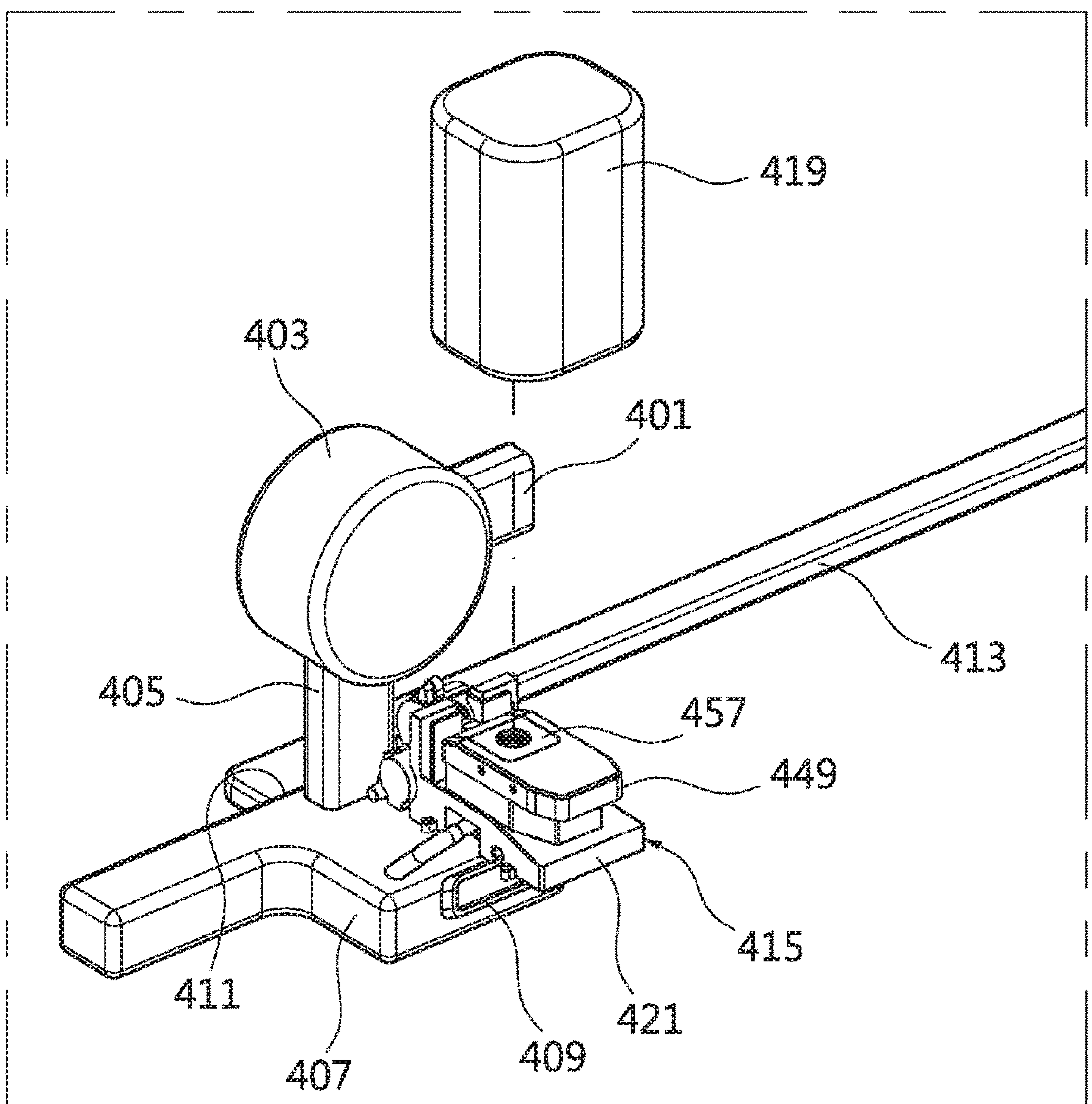


FIGURE 24



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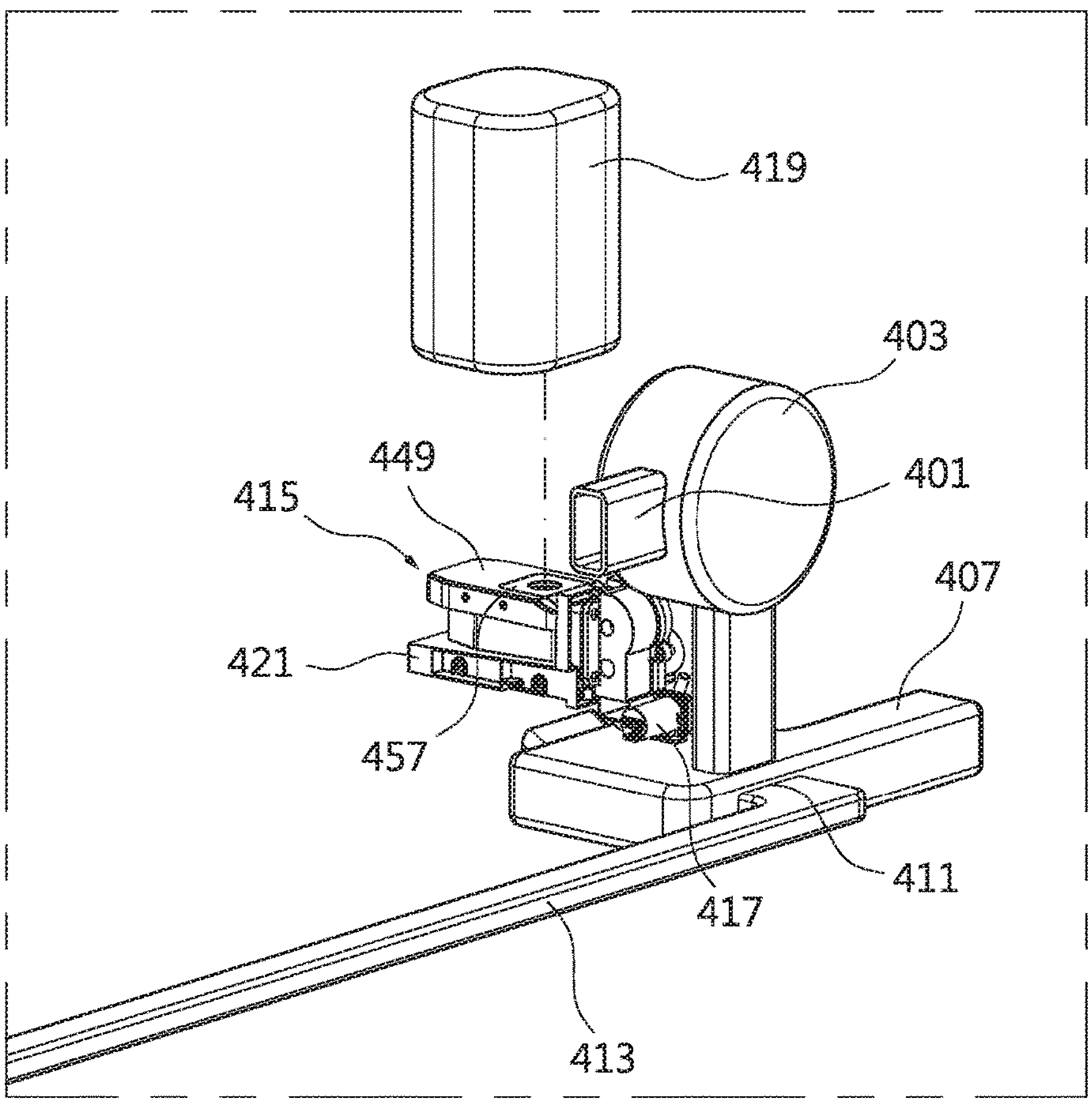

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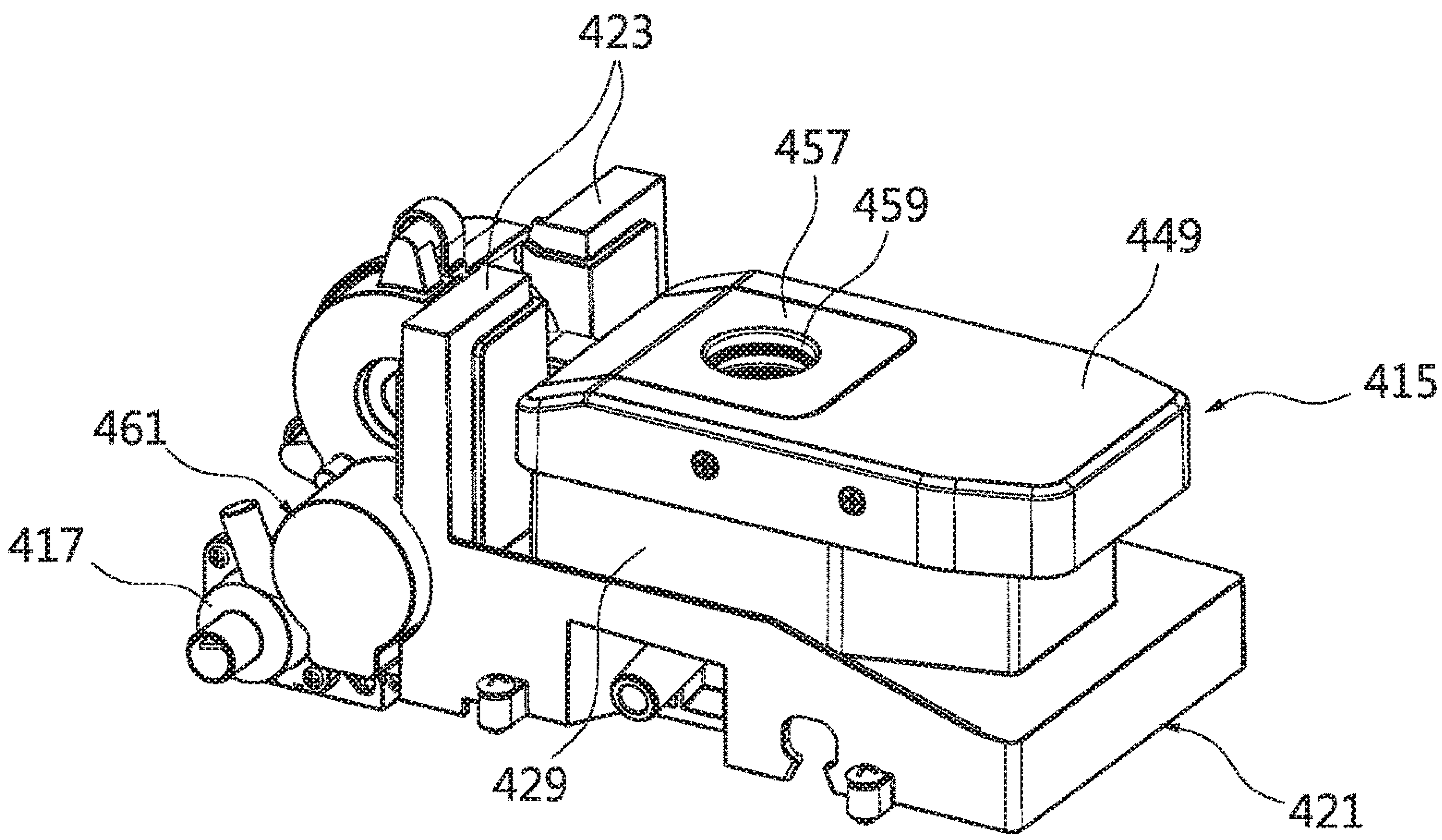

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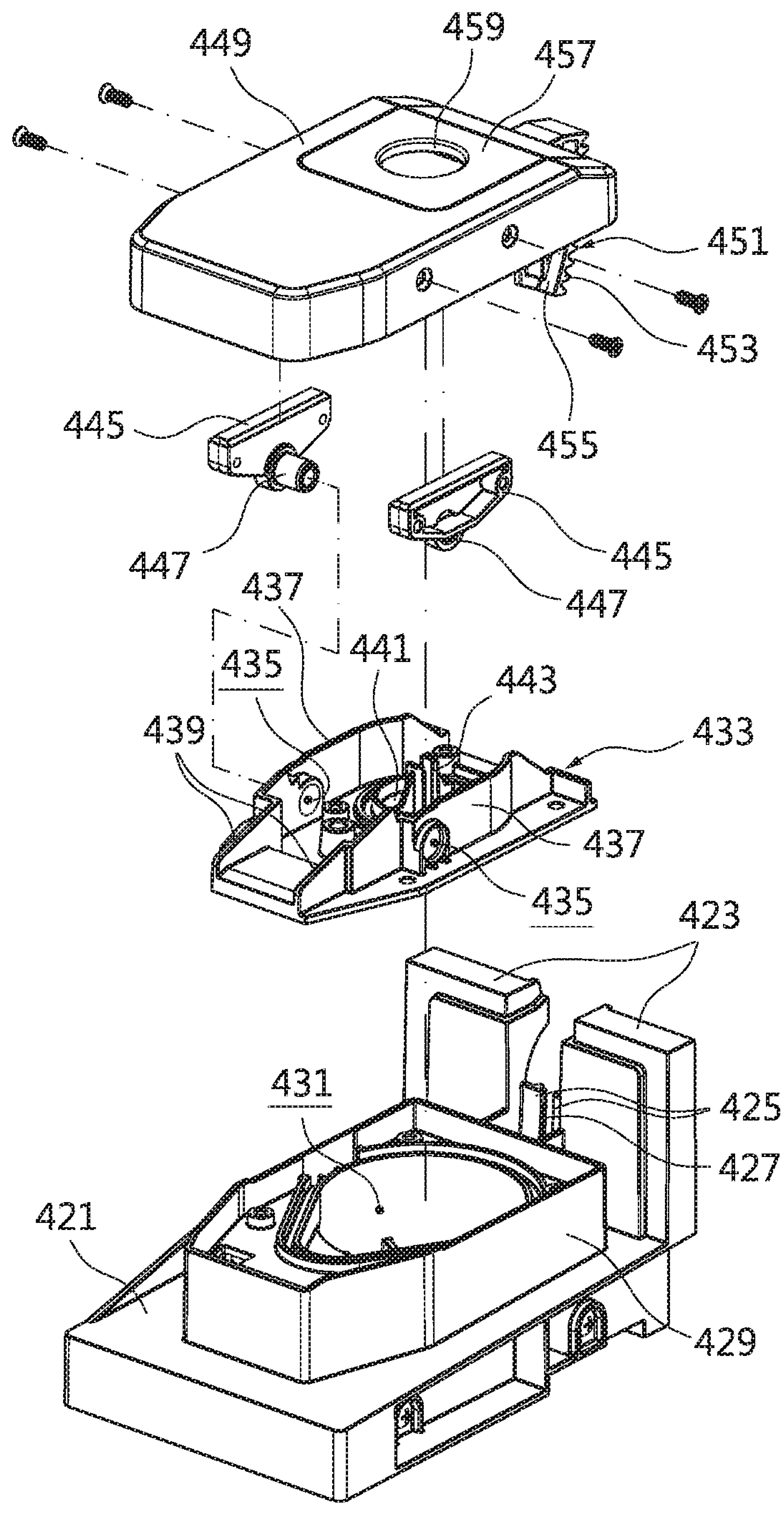
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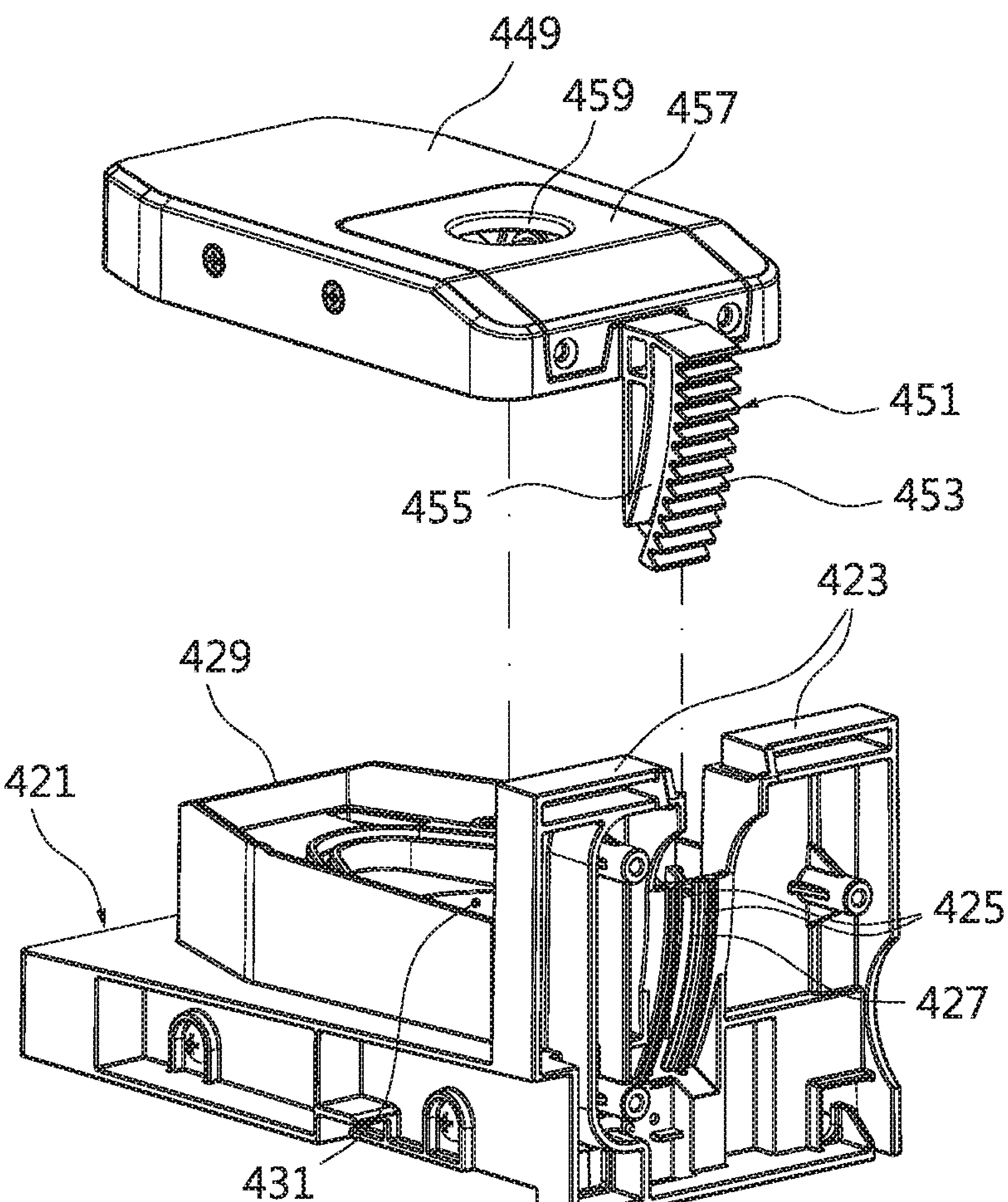
FIGURE 28



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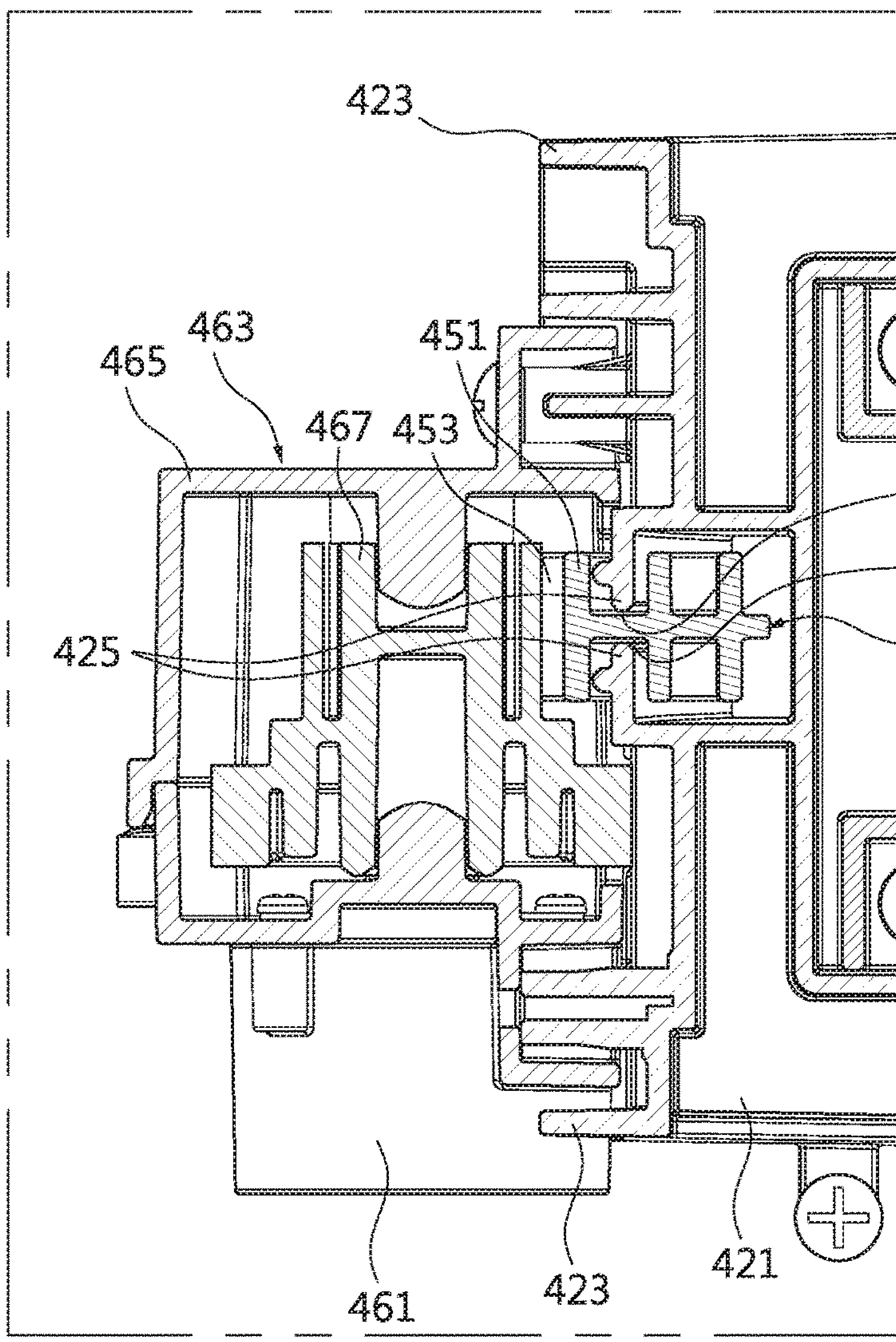
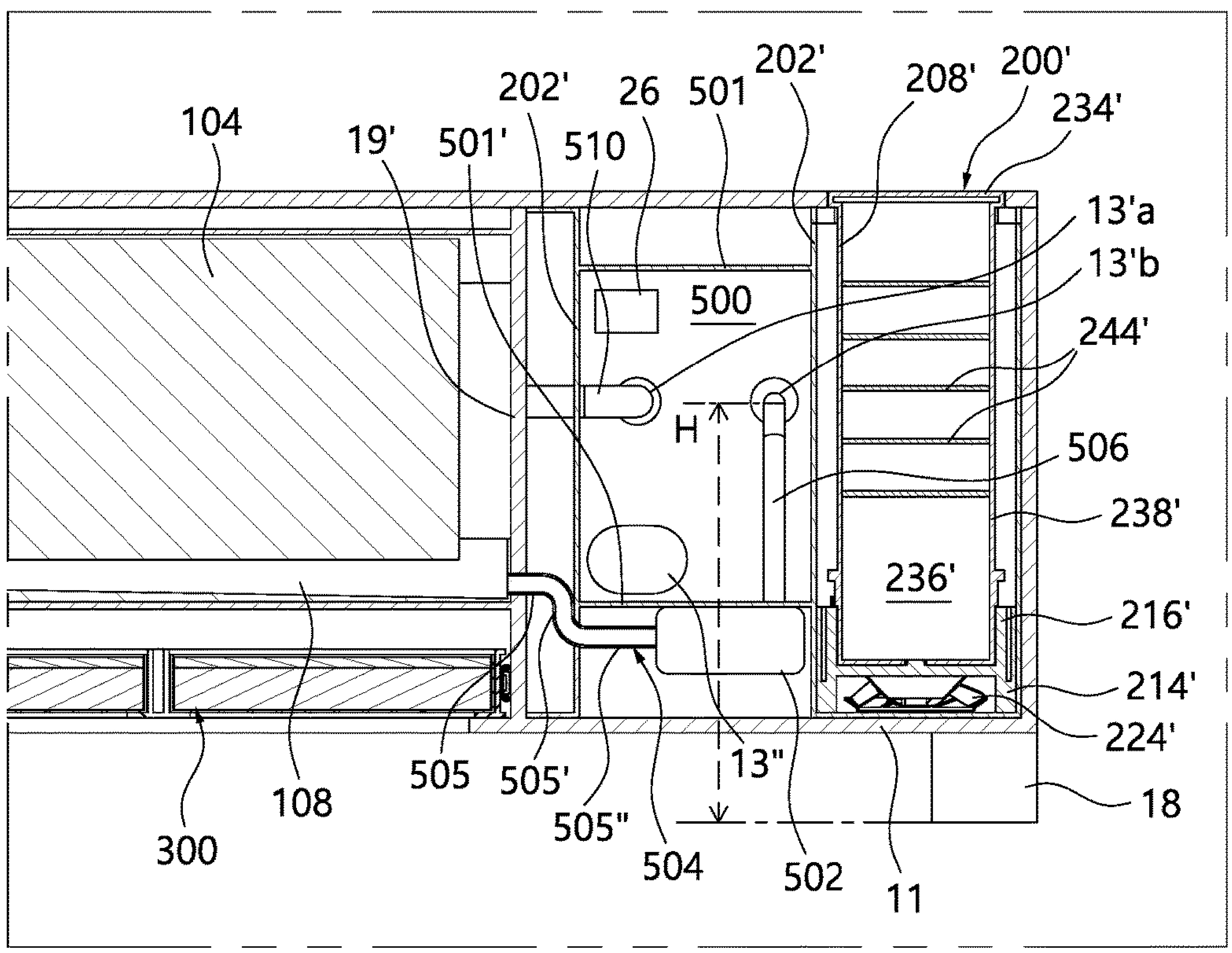


FIGURE 30A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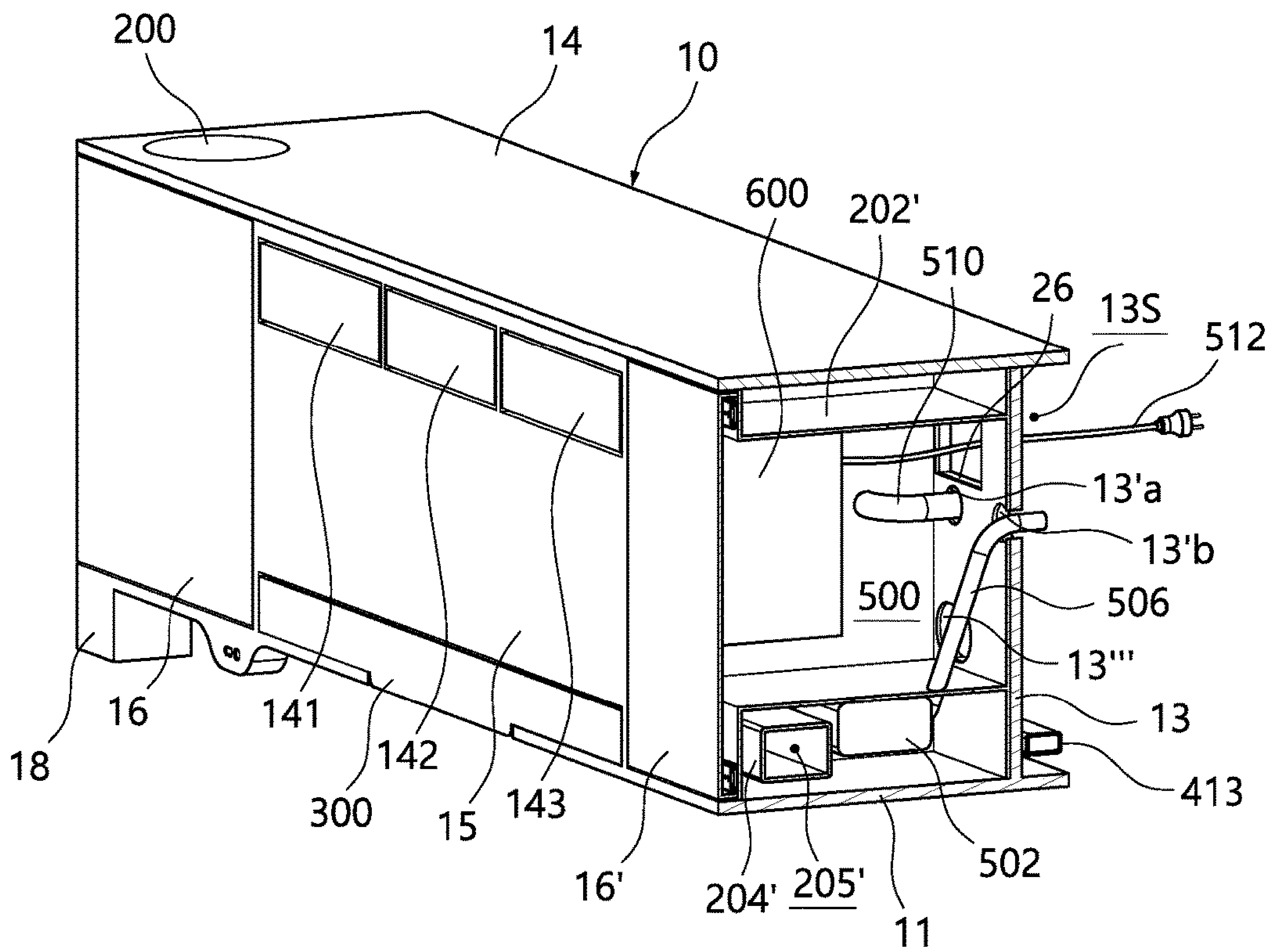
501'
202'
510
26
501
202'
208'
200'
234'
13'a
13'b
500
244'
H
506
238'
236'
216'
214'
224'
18
11
502
504
505"
13"
505'
505
108
300

FIGURE 30B


200
14
10
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202'
510
26
13S
512
13'a
13'b
500
506
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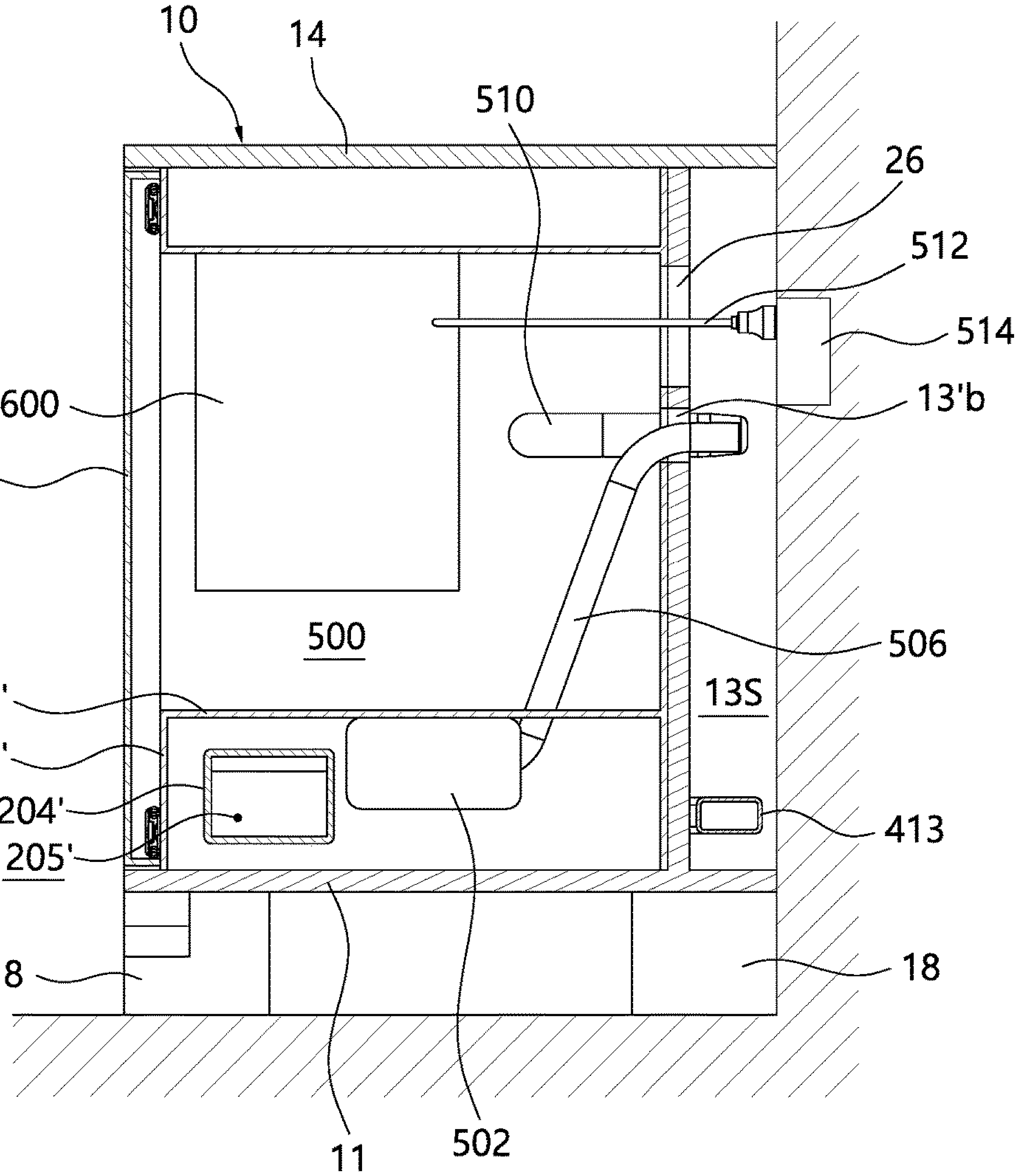
413
18
16
141
142
300
15
143
16'
204'
205'
11
502

FIGURE 30C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514
600
13'b
16'
500
506
501'
13S
202'
204'
413
205'
18
18
11
502

FIGURE 30D

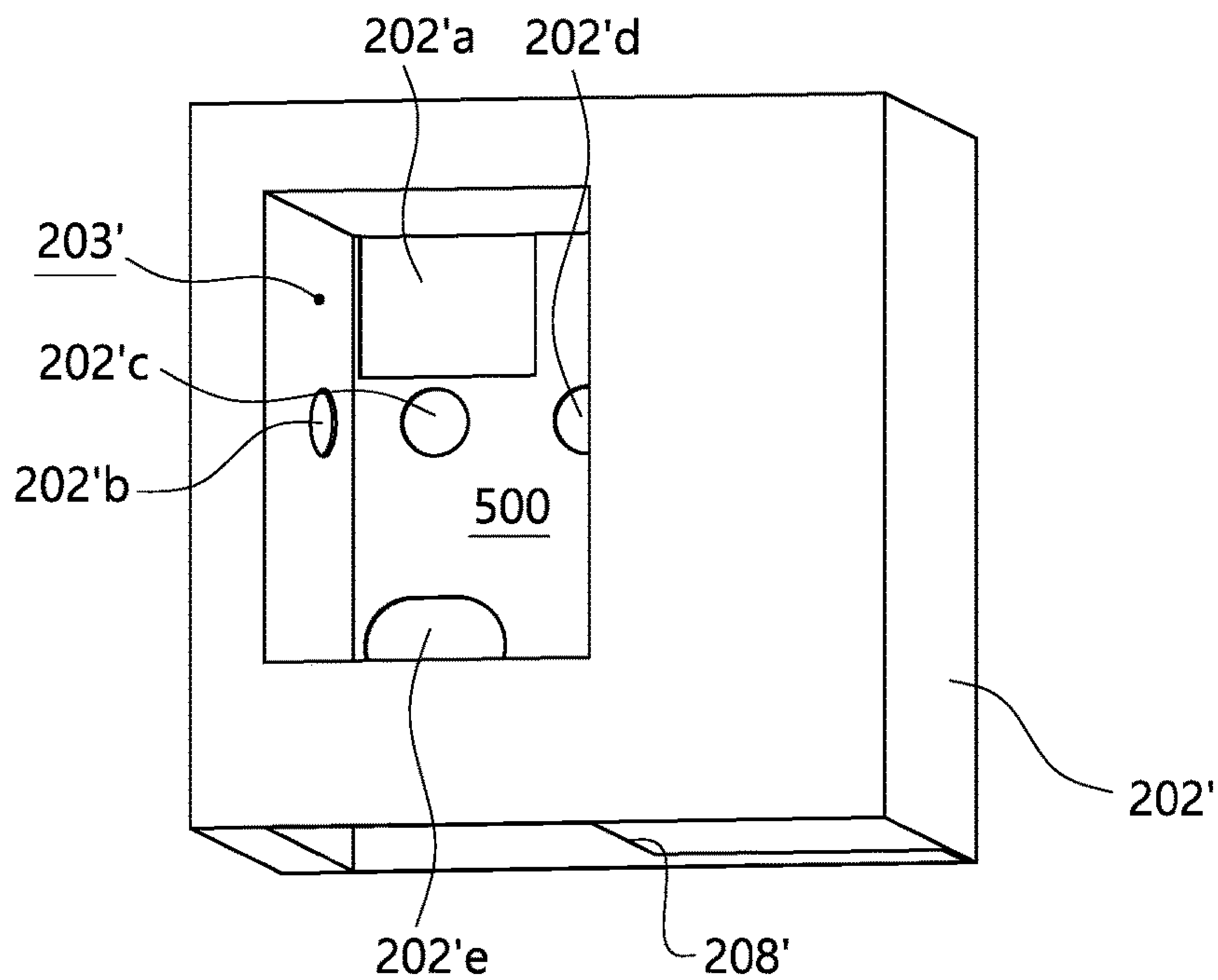


FIGURE 31

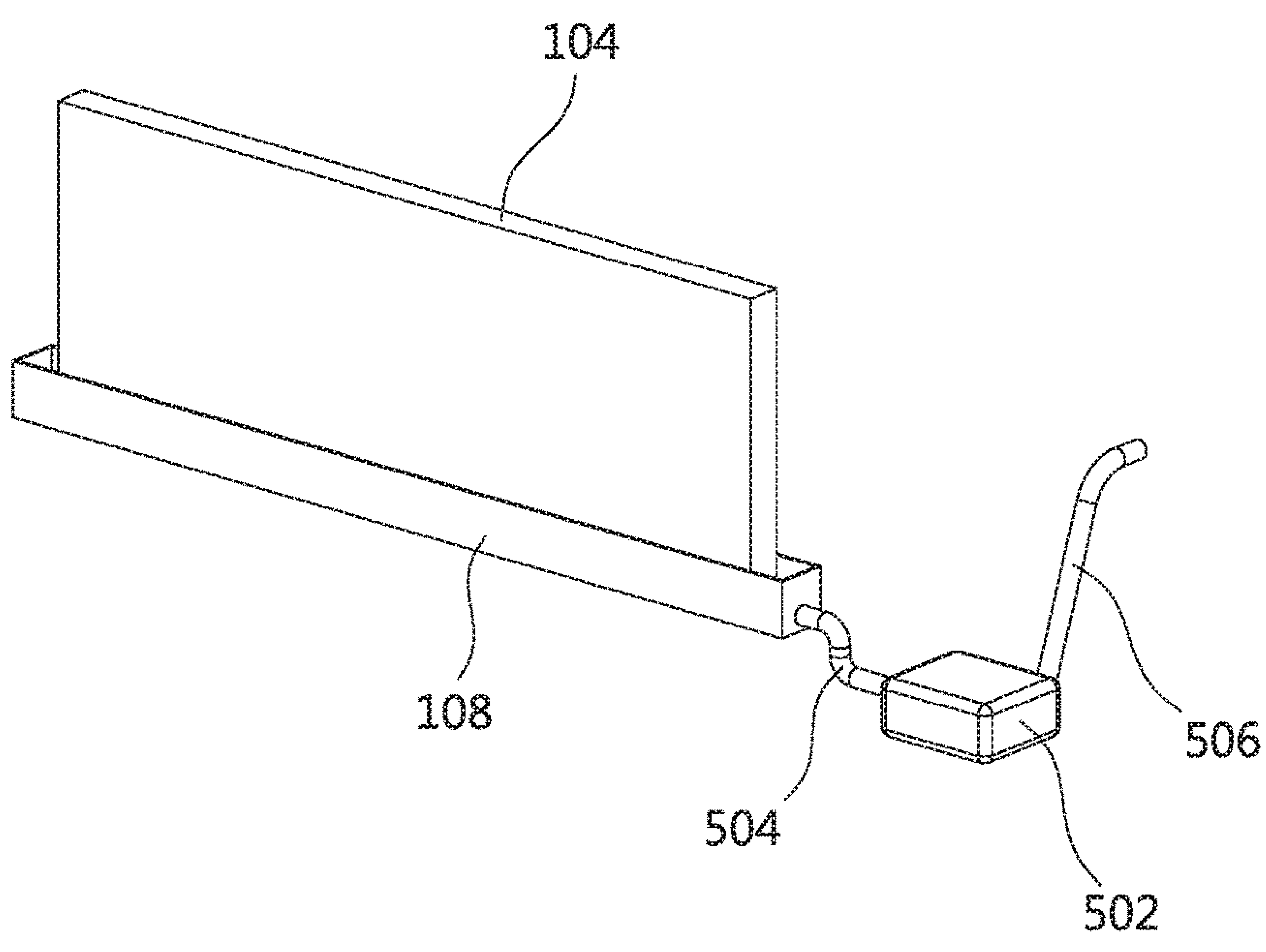


FIGURE 32

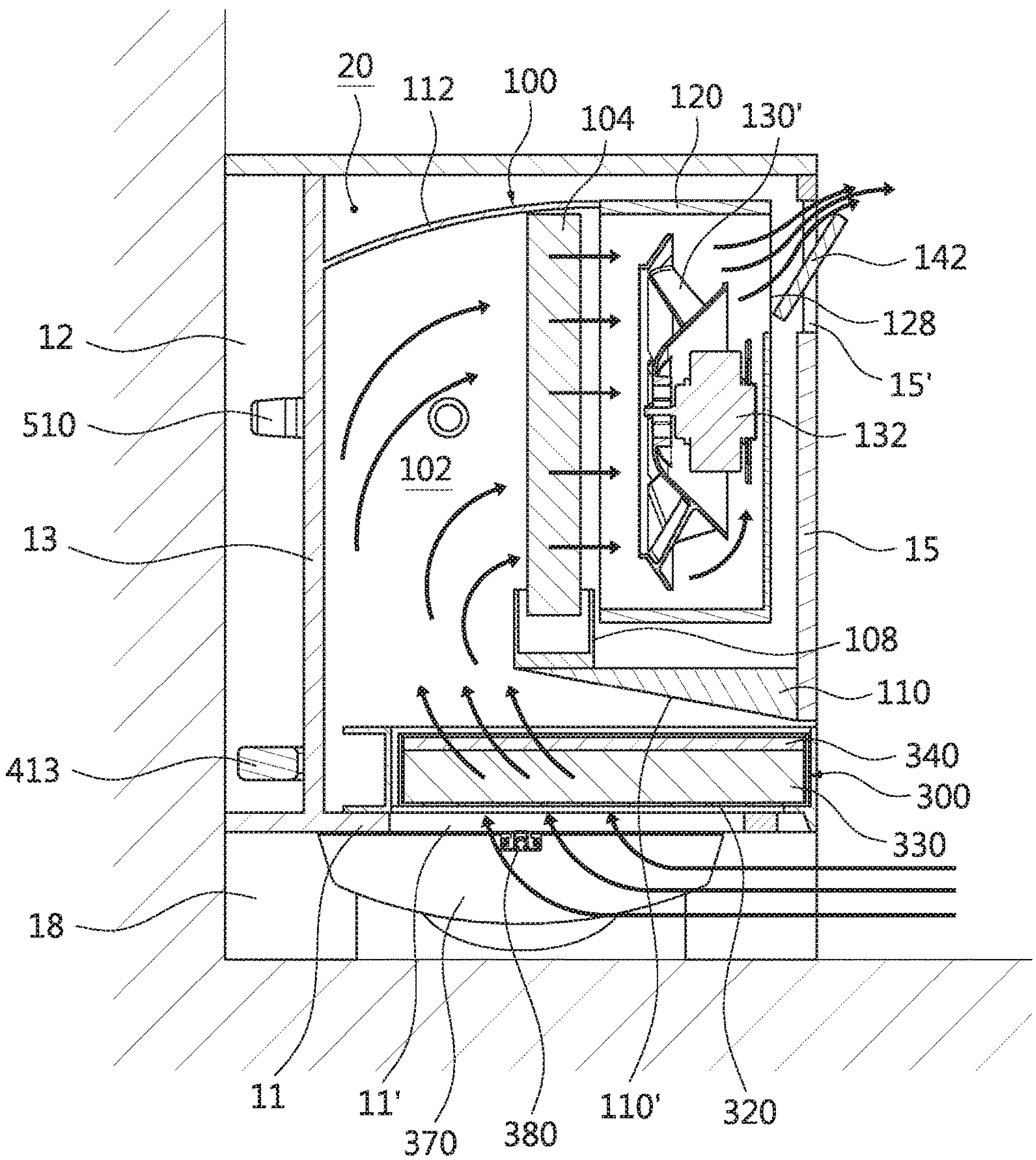

20
112
100
104
120
130'
142
128
15'
132
15
108
110
340
300
330
12
510
102
13
413
18
11
11'
370
380
110'
320

FIGURE 33

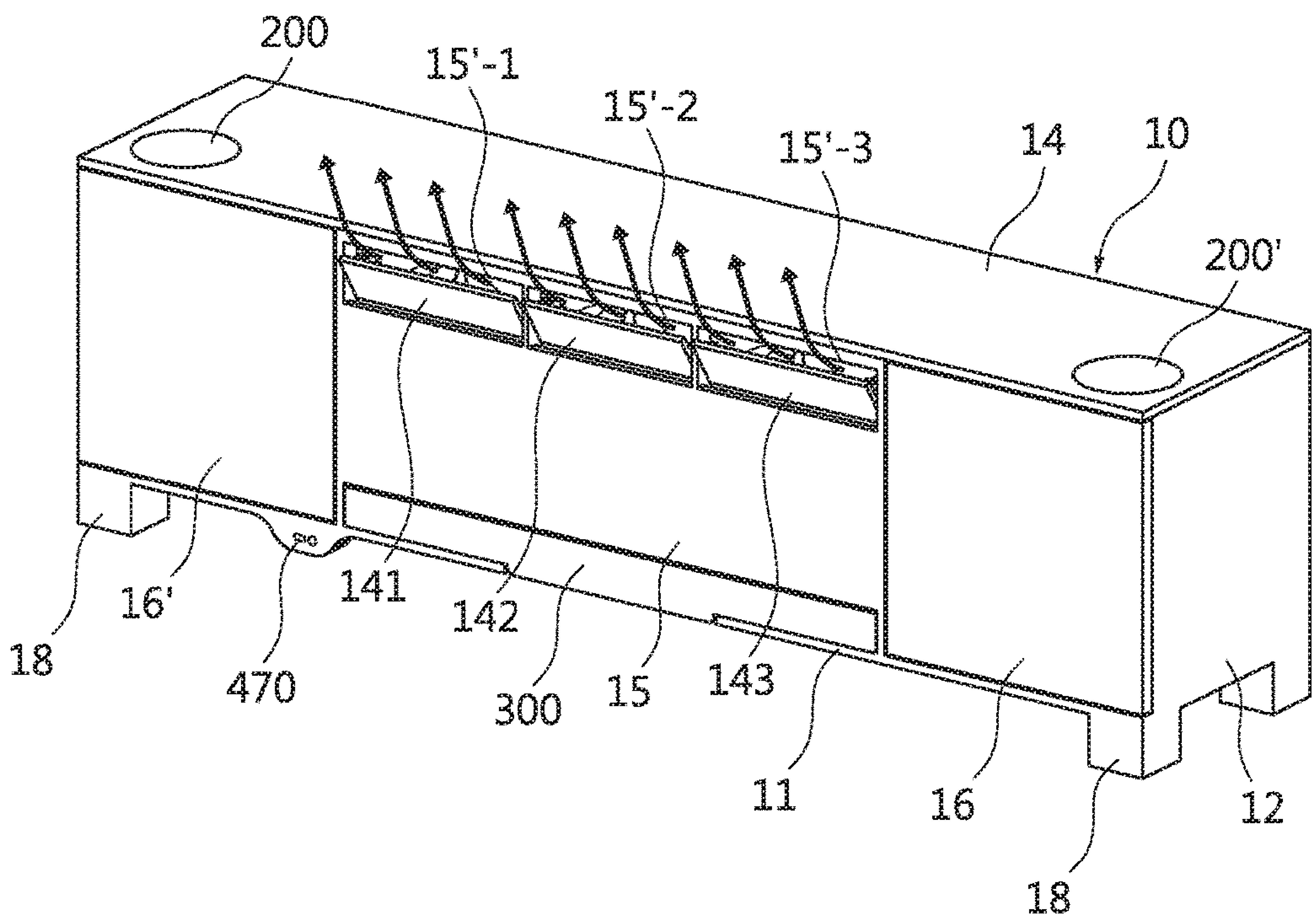


FIGURE 34

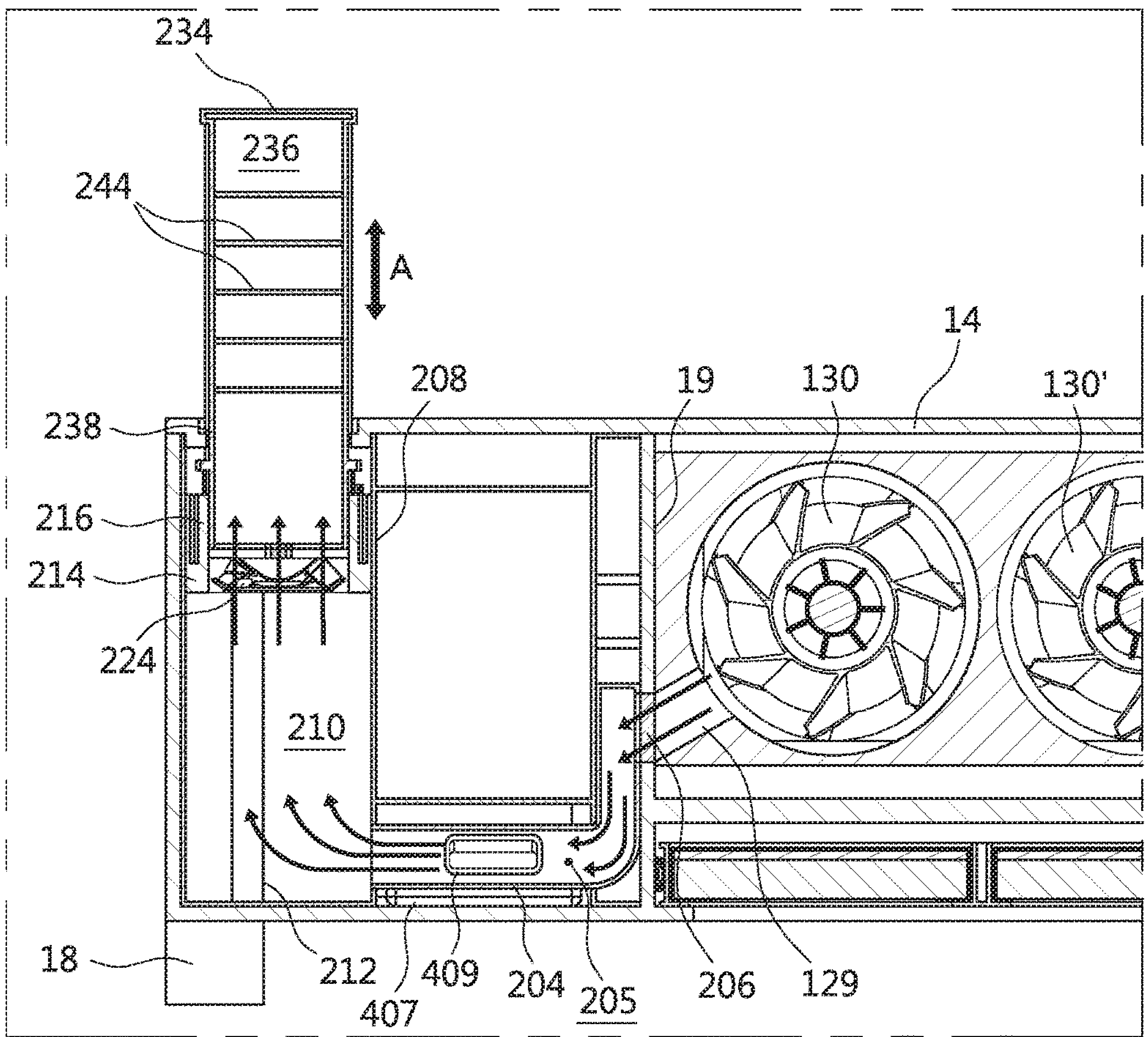

234
236
244
A
14
208
19
130
130'
238
216
214
224
210
18
212
409
204
205
206
129
407

FIGURE 35

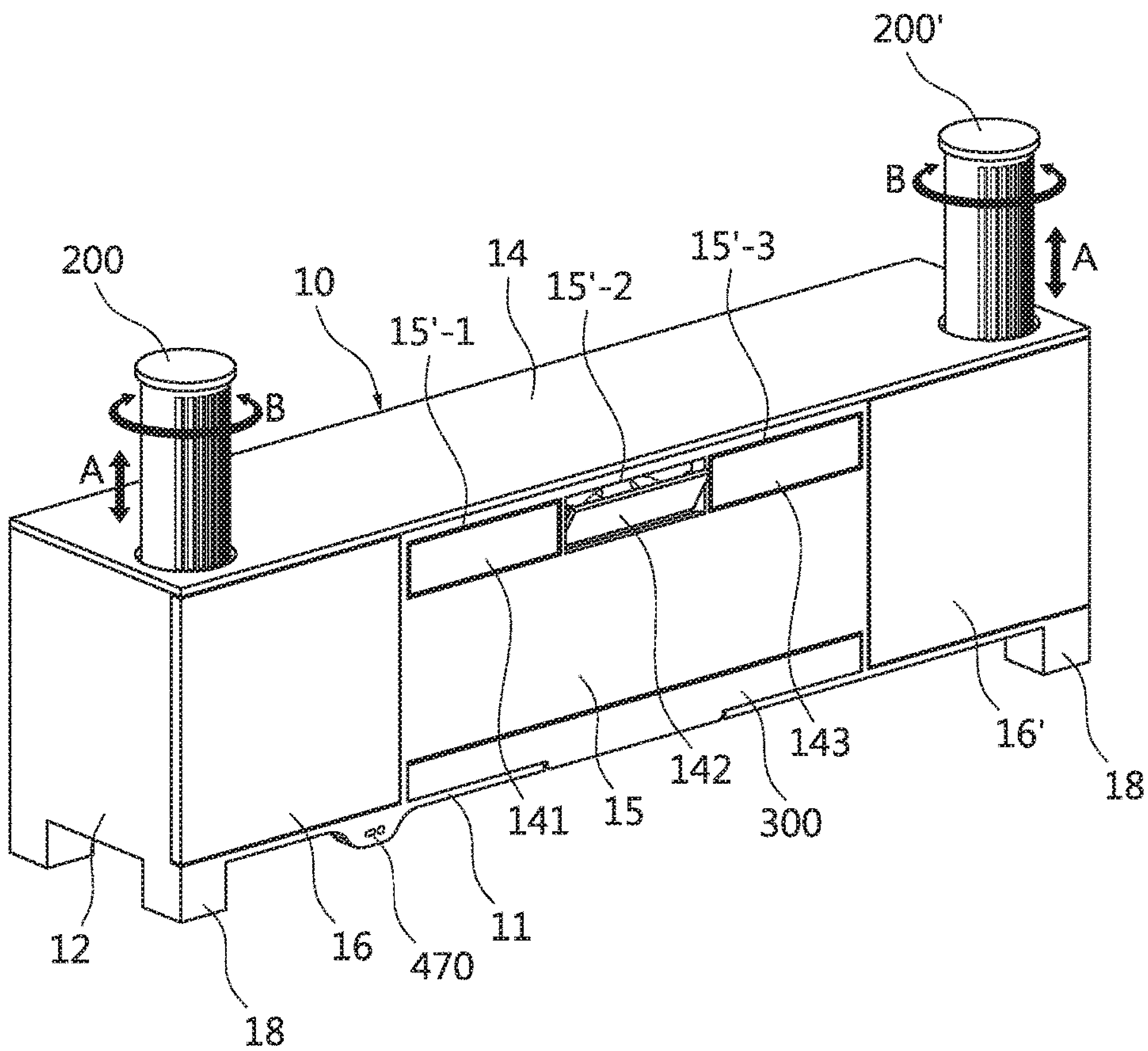

200'
B
A
200
10
14
15'-3
15'-2
15'-1
B
A
141
15
142
143
300
16'
18
12
16
470
11
18

FIGURE 36

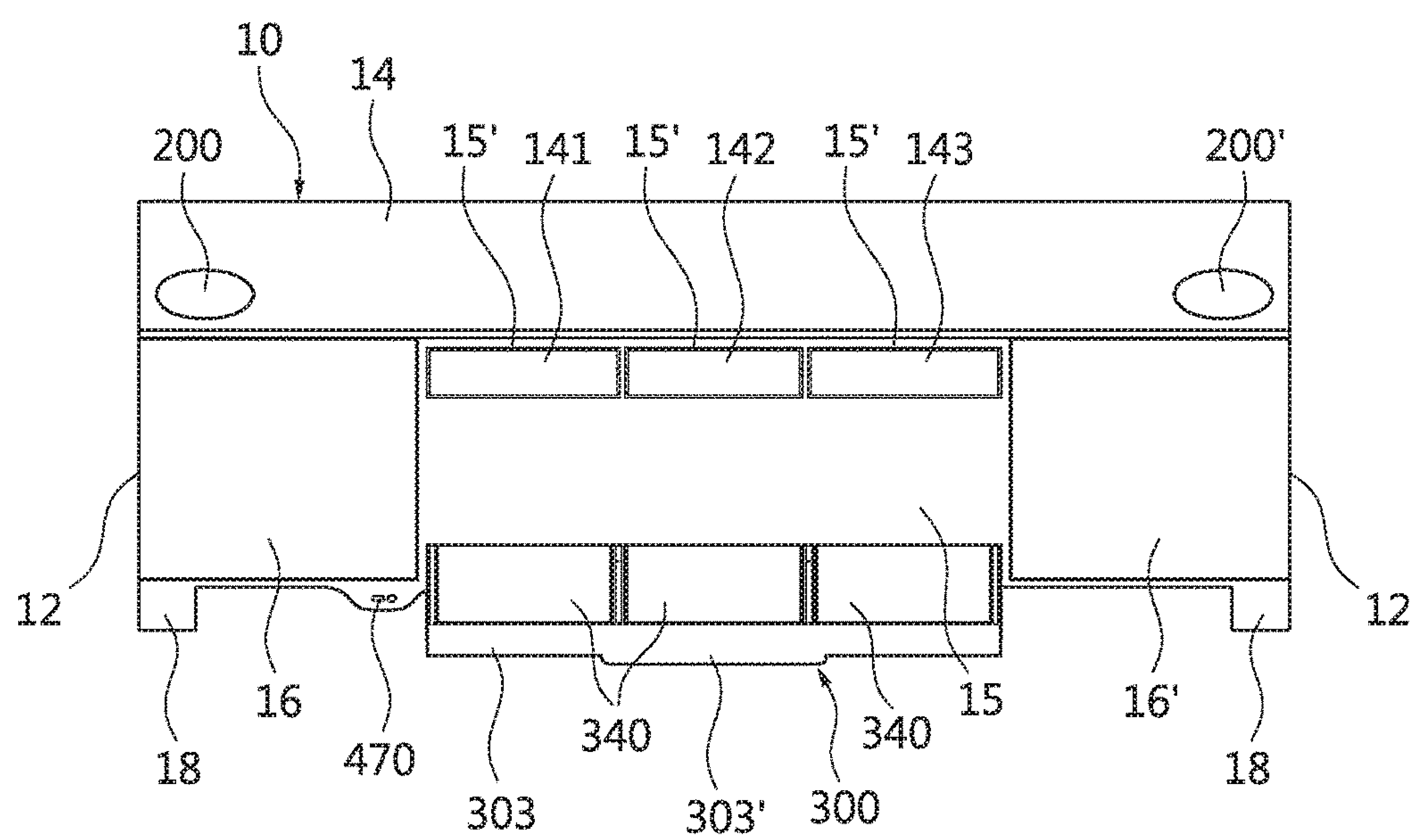
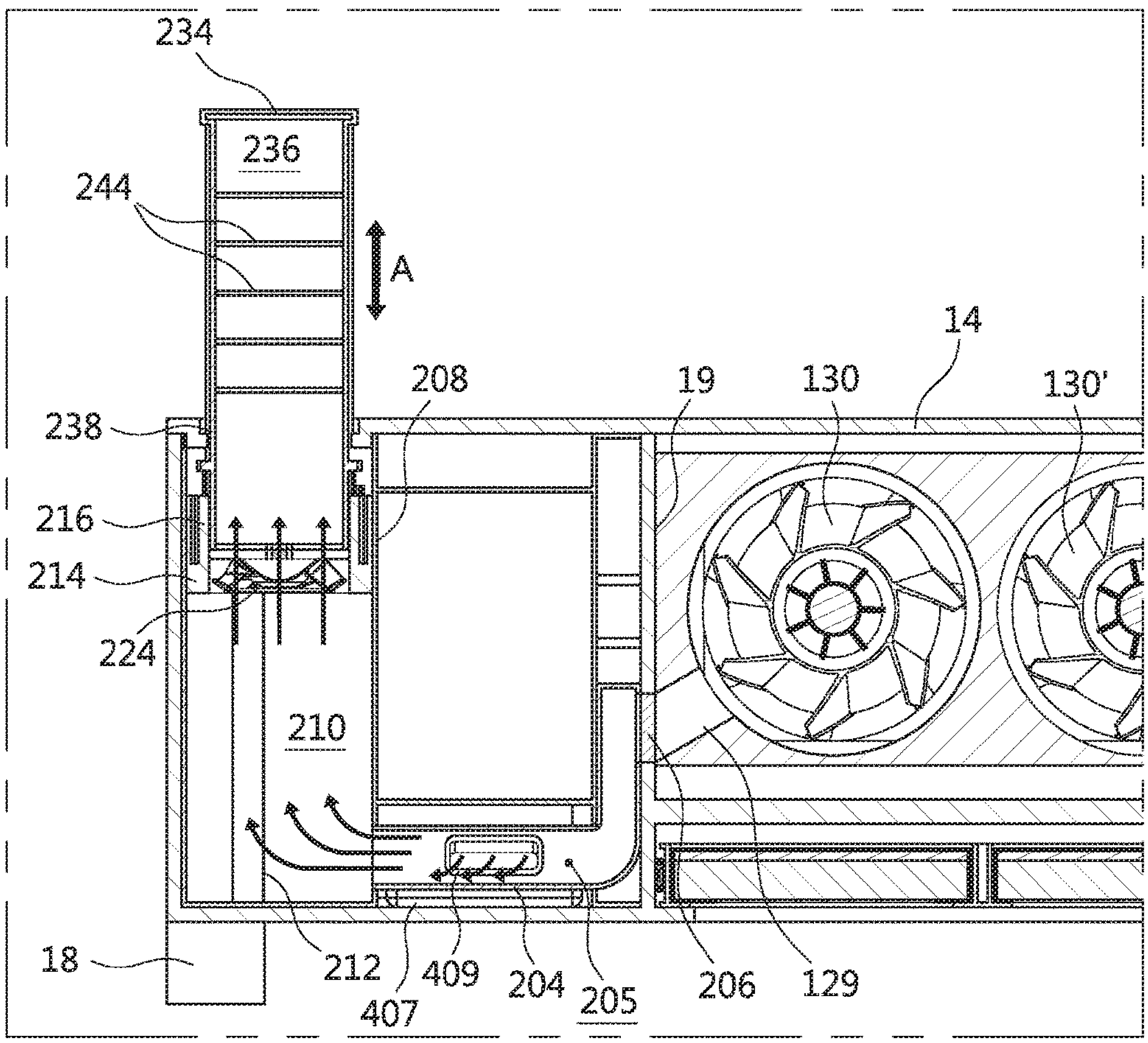

10
14
200
15'
141
15'
142
15'
143
200'
12
12
18
16
470
303
340
303'
300
340
15
16'
18

FIGURE 37



234
236
244
A
14
208
19
130
130'
238
216
214
224
210
18
212
409
204
205
206
129
407

FIGURE 38

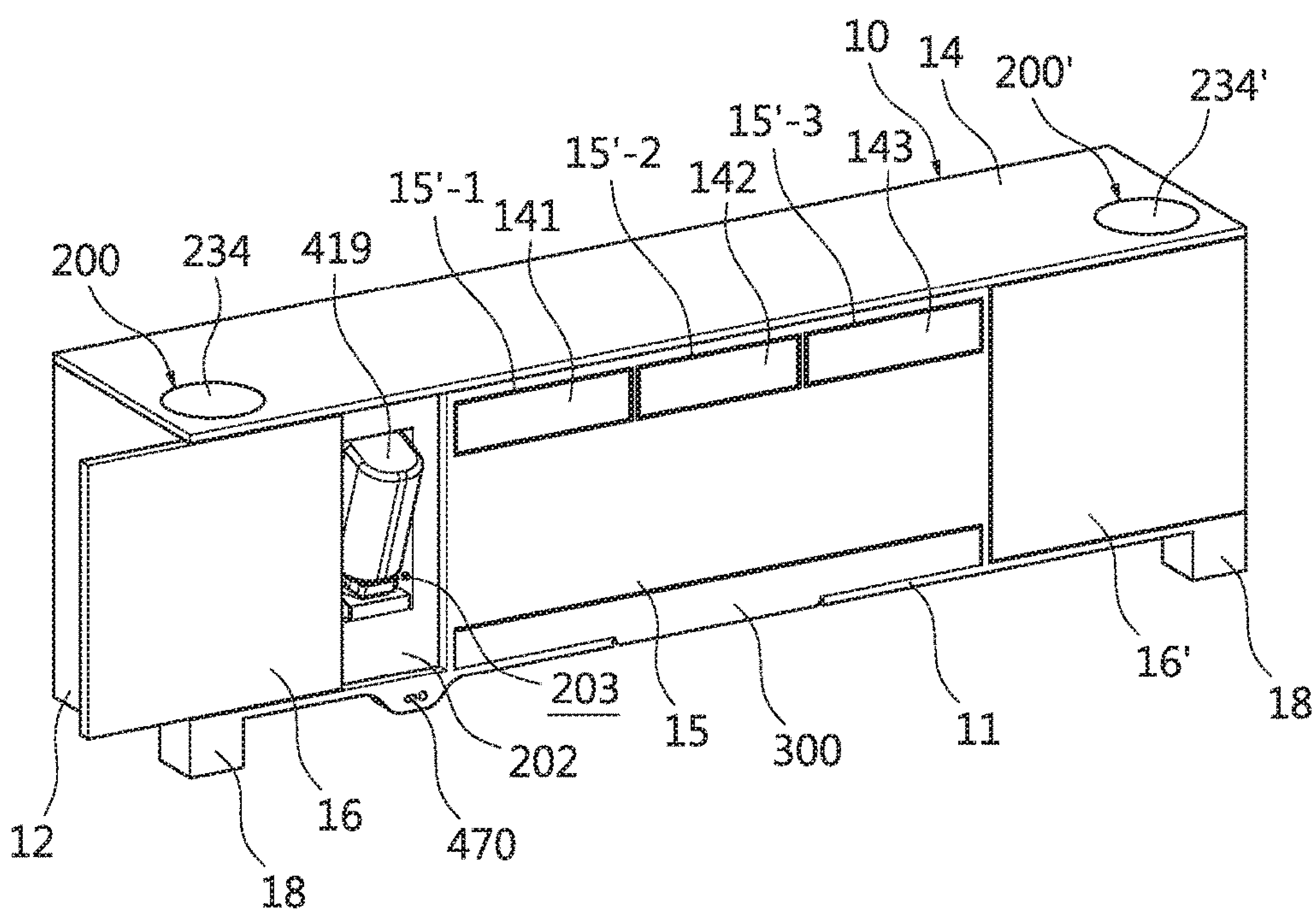

10
14
200'
234'
15'-3
143
15'-2
142
15'-1
141
200
234
419
203
15
300
11
16'
18
12
16
202
470
18

FIGURE 39

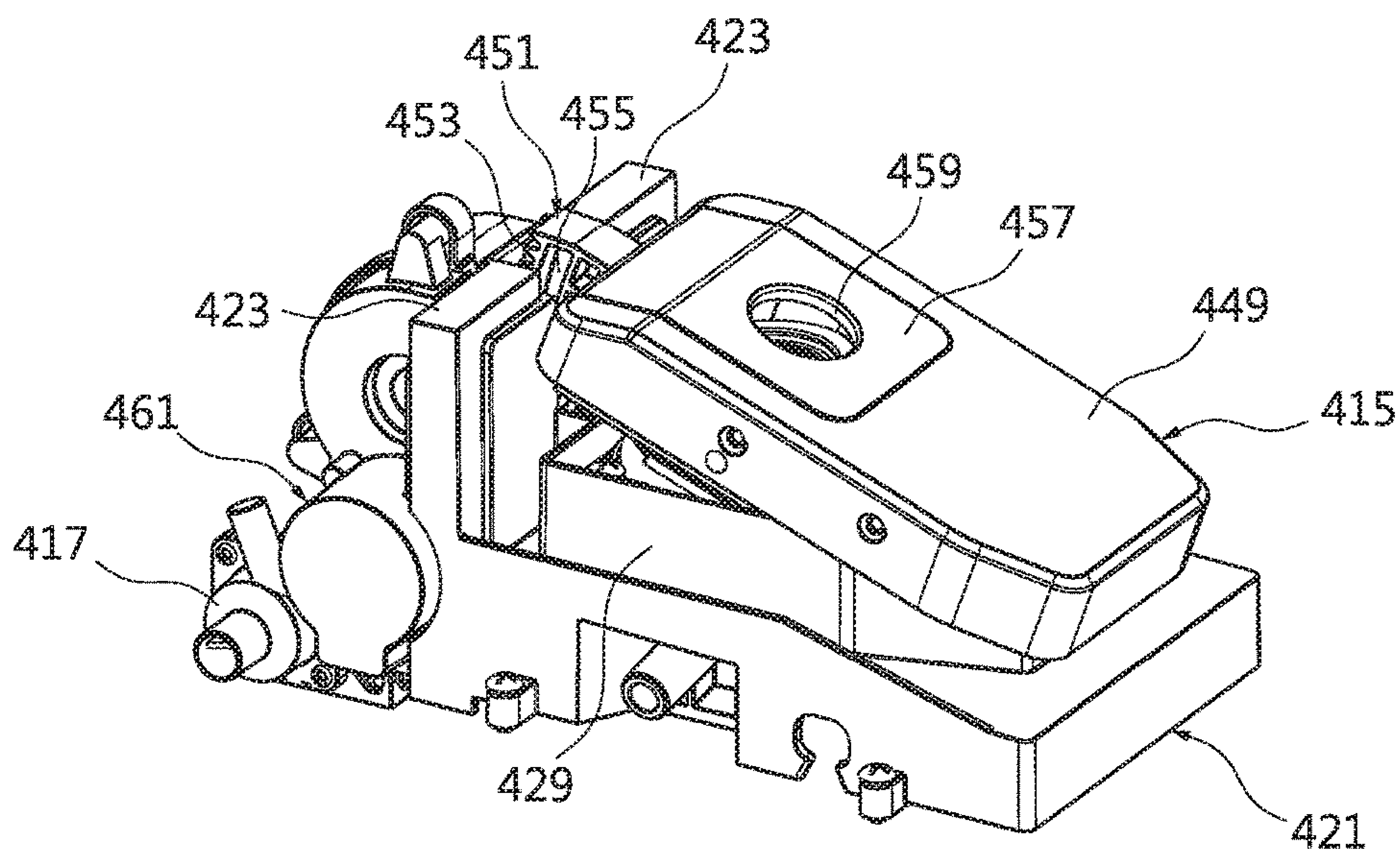


FIGURE 40

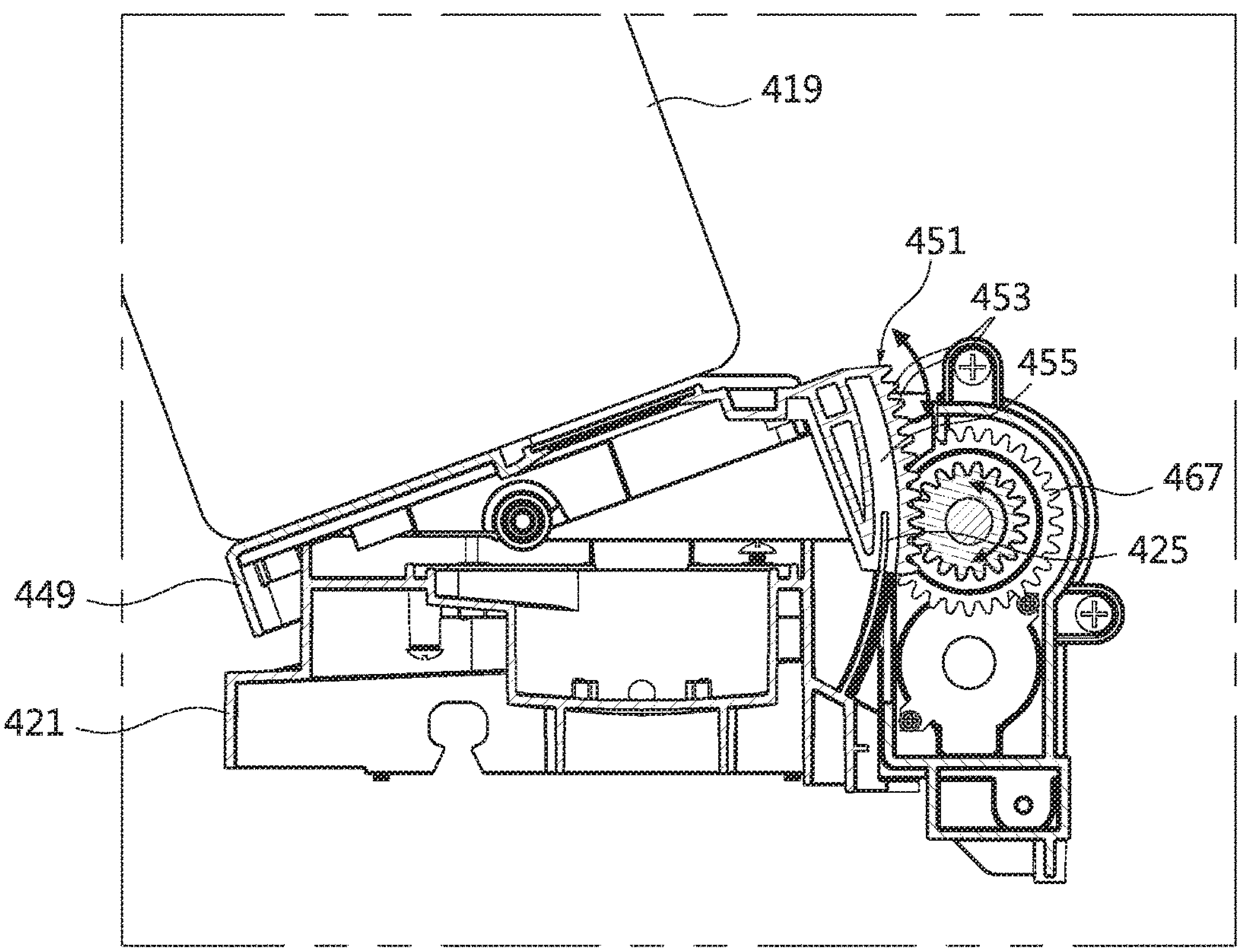


FIGURE 41

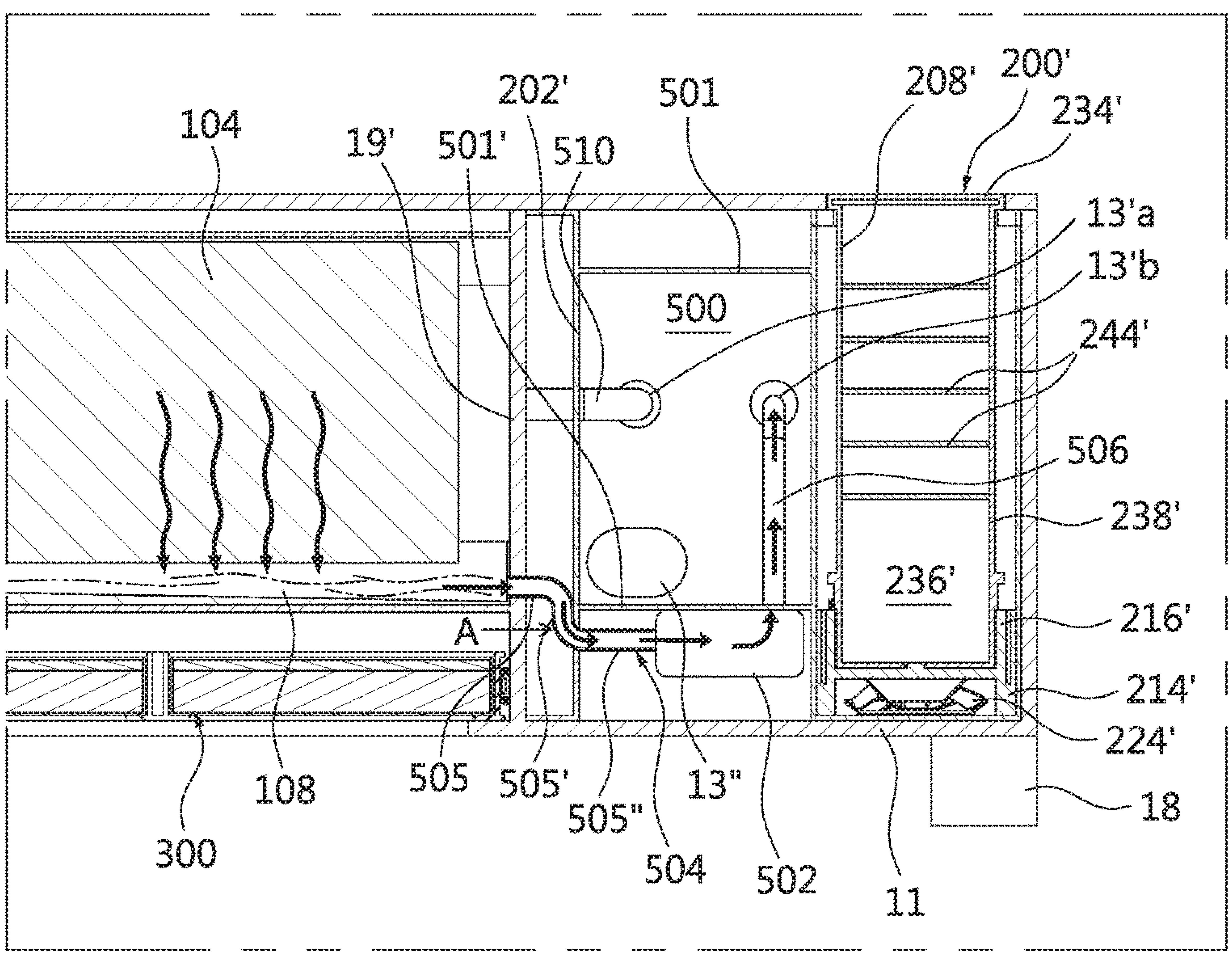

104
19'
501'
202'
510
501
208'
200'
234'
13'a
13'b
500
244'
506
238'
236'
216'
214'
224'
18
A
300
108
505
505'
505"
13"
504
502
11

FIGURE 42

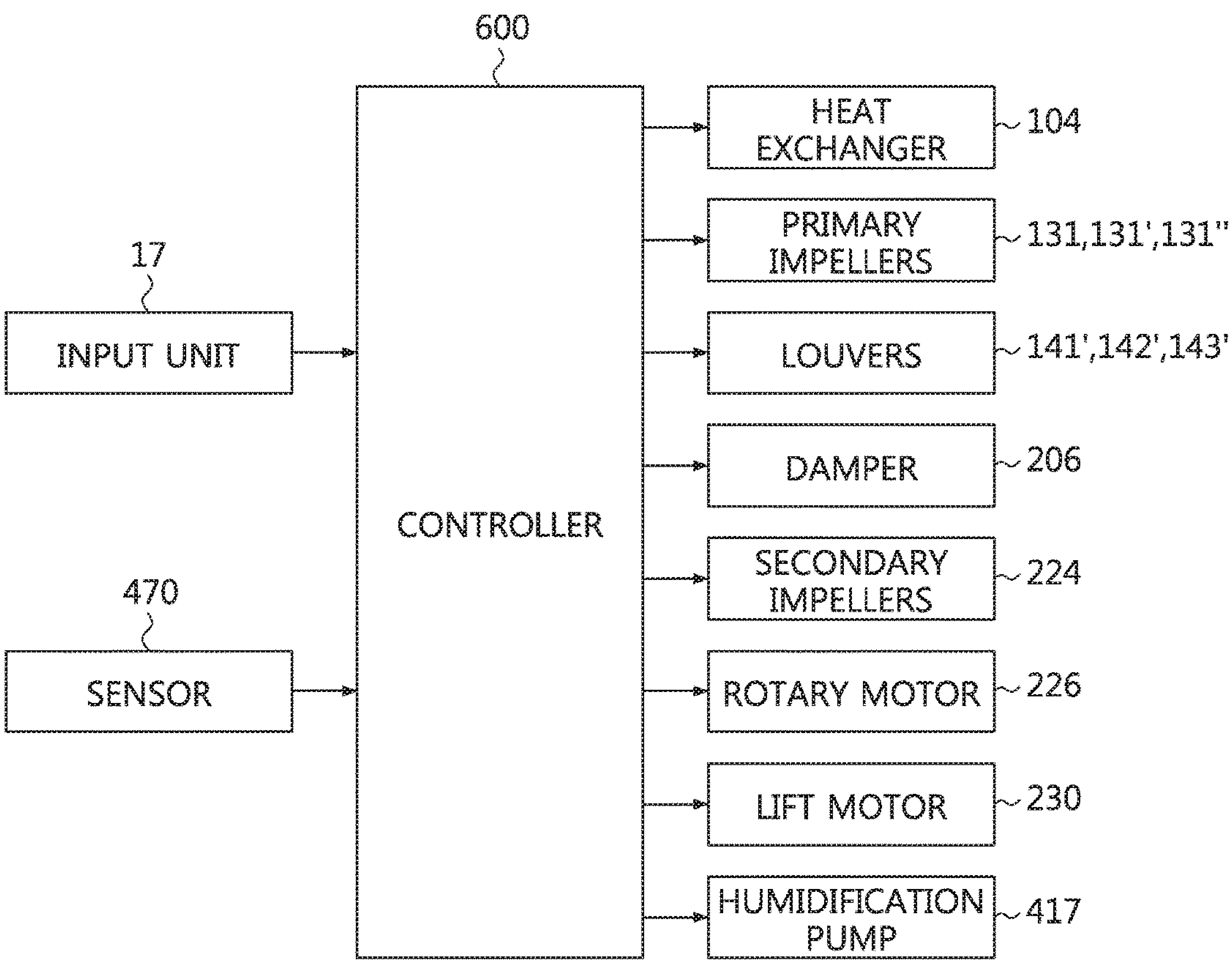

600
17
INPUT UNIT
470
SENSOR
CONTROLLER
HEAT EXCHANGER
104
PRIMARY IMPELLERS
131,131',131"
LOUVERS
141',142',143'
DAMPER
206
SECONDARY IMPELLERS
224
ROTARY MOTOR
226
LIFT MOTOR
230
HUMIDIFICATION PUMP
417

FIGURE 43

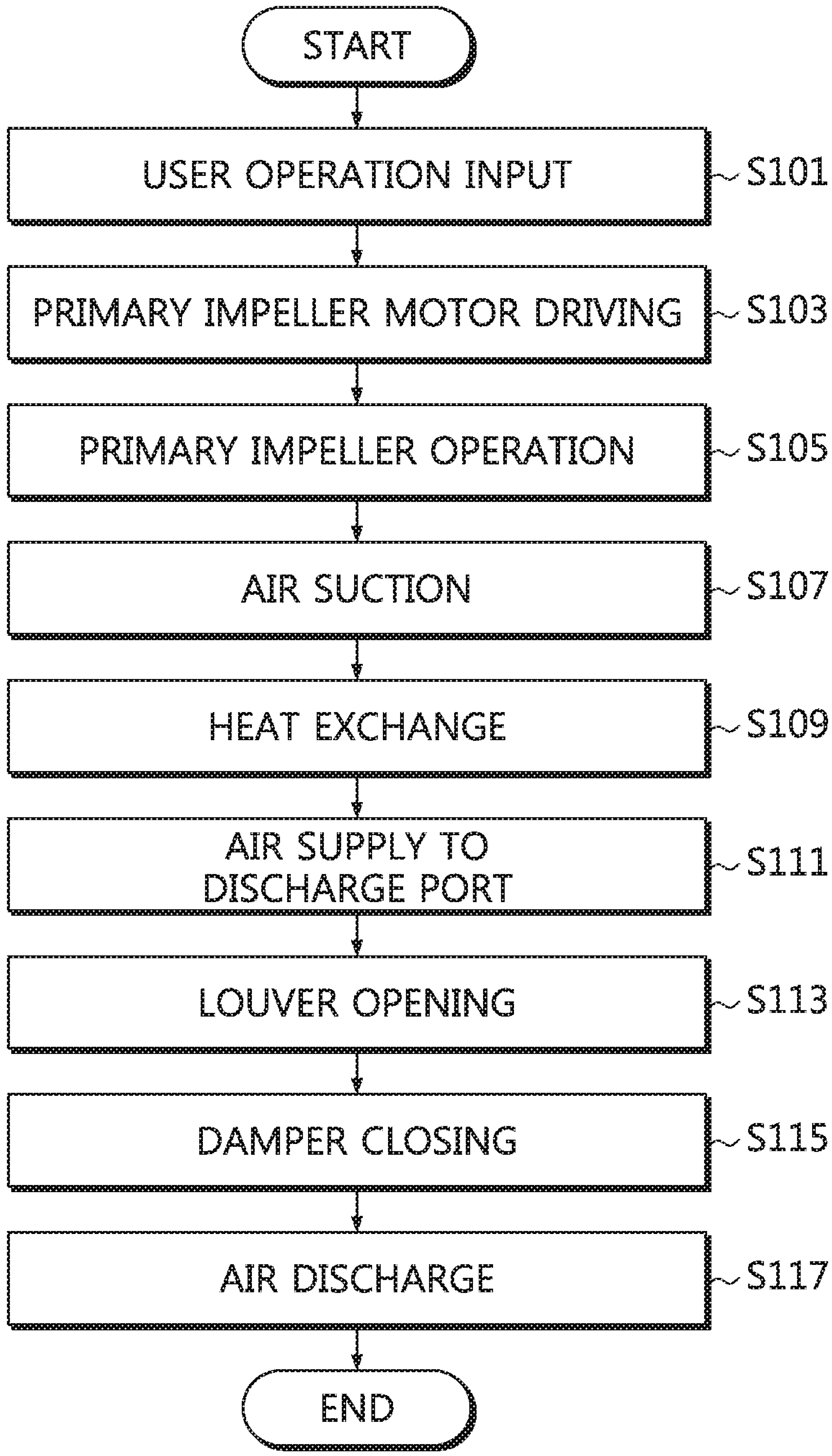

START
USER OPERATION INPUT
S101
PRIMARY IMPELLER MOTOR DRIVING
S103
PRIMARY IMPELLER OPERATION
S105
AIR SUCTION
S107
HEAT EXCHANGE
S109
AIR SUPPLY TO DISCHARGE PORT
S111
LOUVER OPENING
S113
DAMPER CLOSING
S115
AIR DISCHARGE
S117
END

FIGURE 44

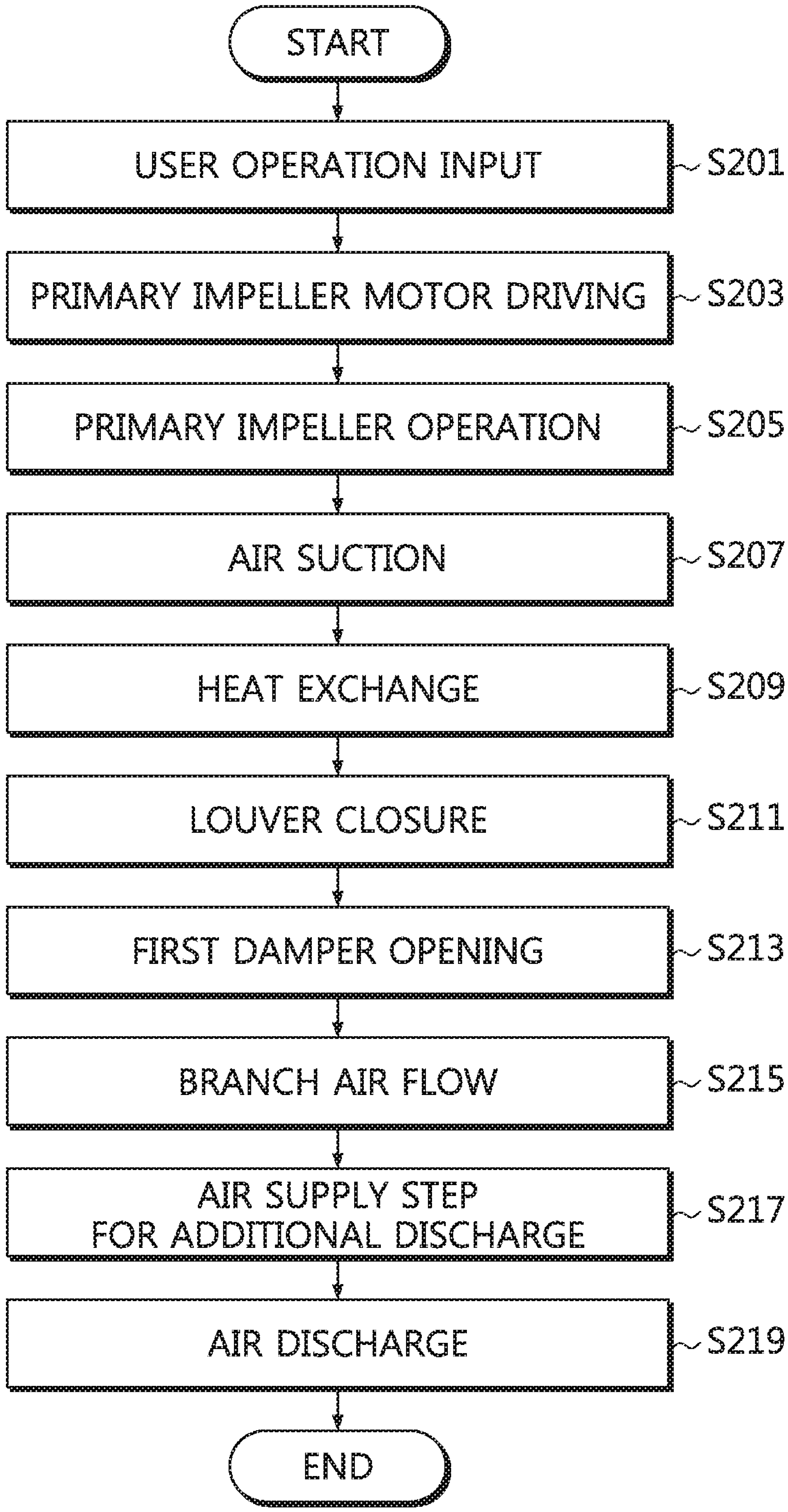

START
USER OPERATION INPUT
S201
PRIMARY IMPELLER MOTOR DRIVING
S203
PRIMARY IMPELLER OPERATION
S205
AIR SUCTION
S207
HEAT EXCHANGE
S209
LOUVER CLOSURE
S211
FIRST DAMPER OPENING
S213
BRANCH AIR FLOW
S215
AIR SUPPLY STEP FOR ADDITIONAL DISCHARGE
S217
AIR DISCHARGE
S219
END

FIGURE 45

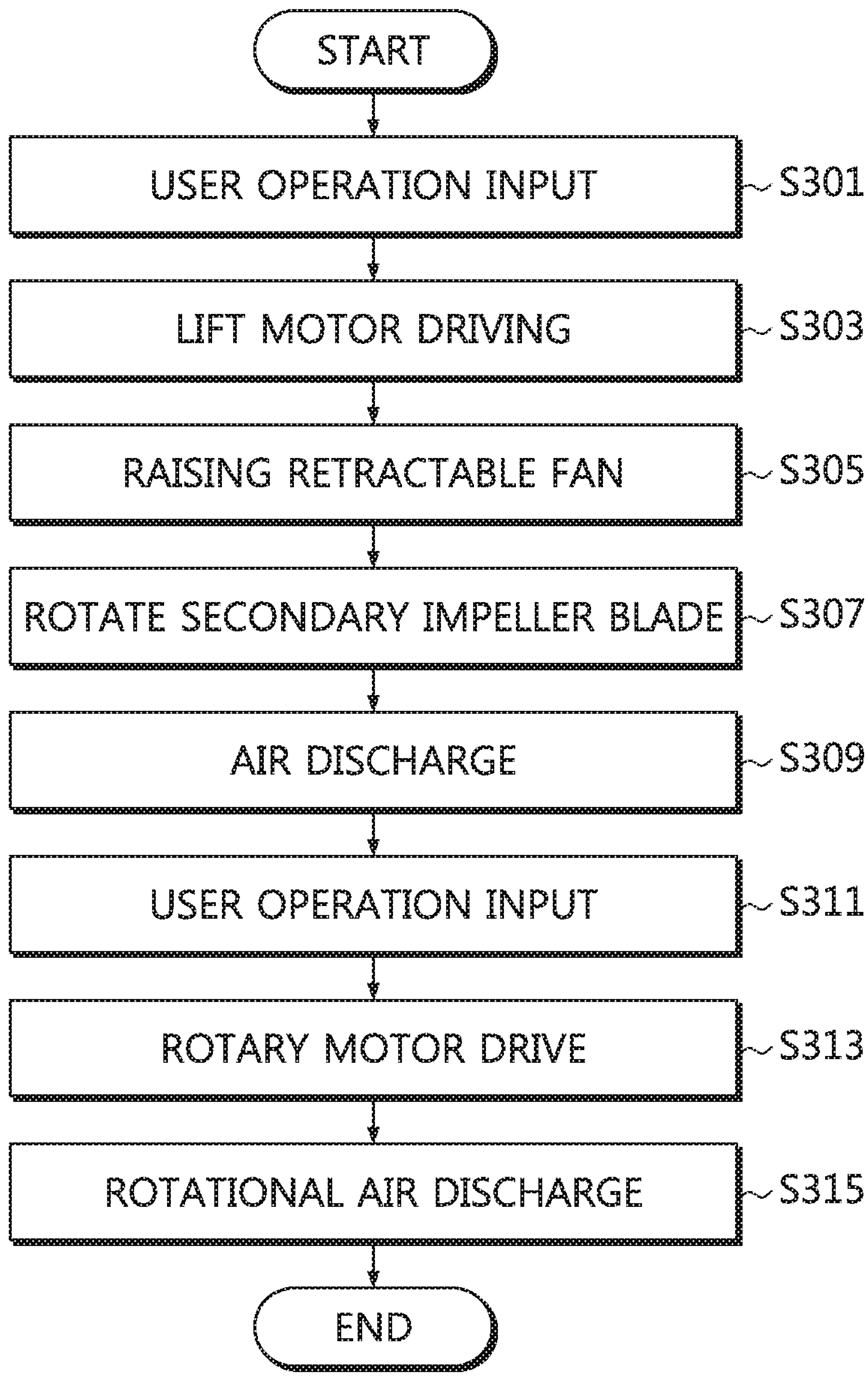

START
USER OPERATION INPUT
S301
LIFT MOTOR DRIVING
S303
RAISING RETRACTABLE FAN
S305
ROTATE SECONDARY IMPELLER BLADE
S307
AIR DISCHARGE
S309
USER OPERATION INPUT
S311
ROTARY MOTOR DRIVE
S313
ROTATIONAL AIR DISCHARGE
S315
END

FIGURE 46

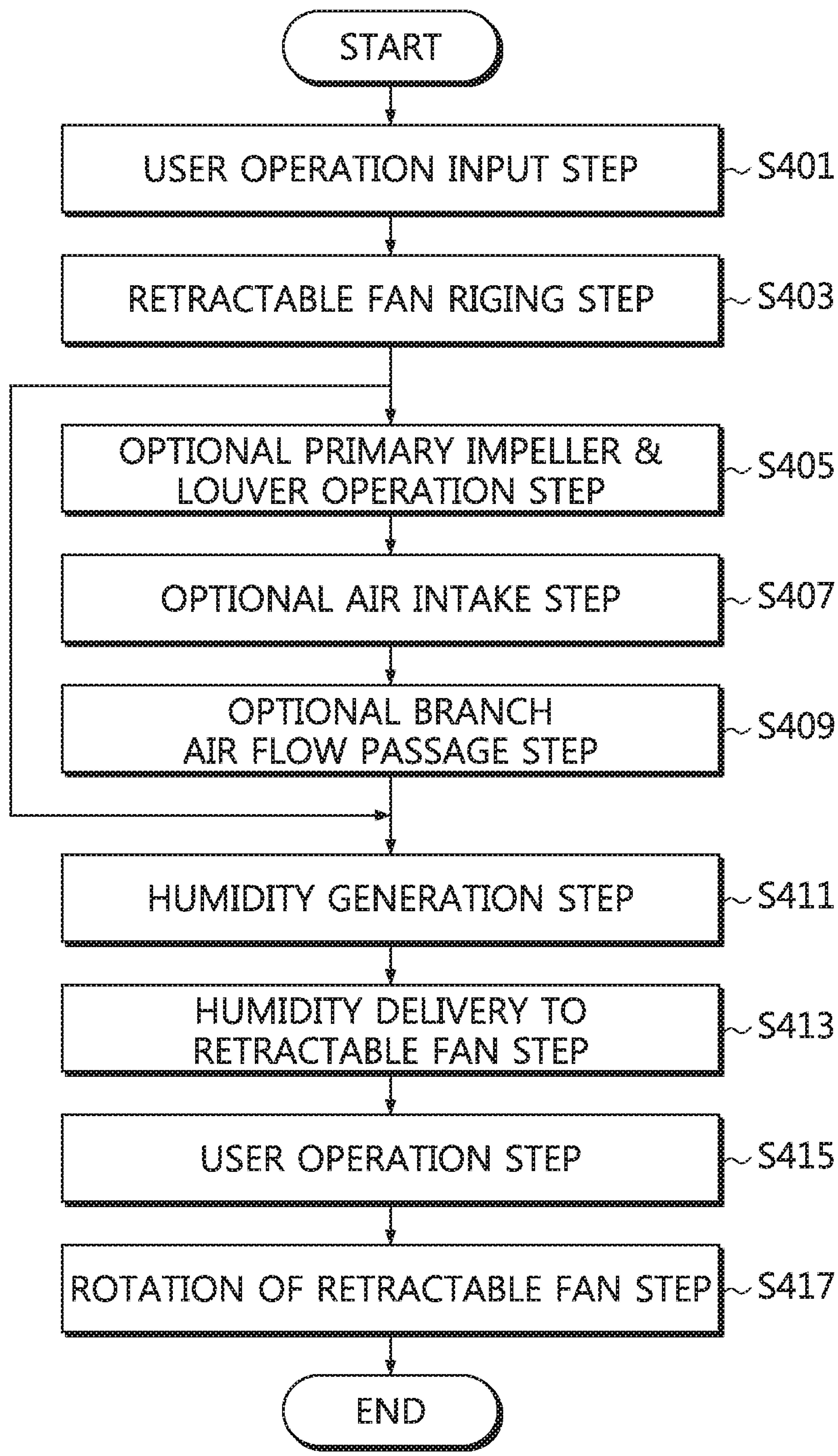
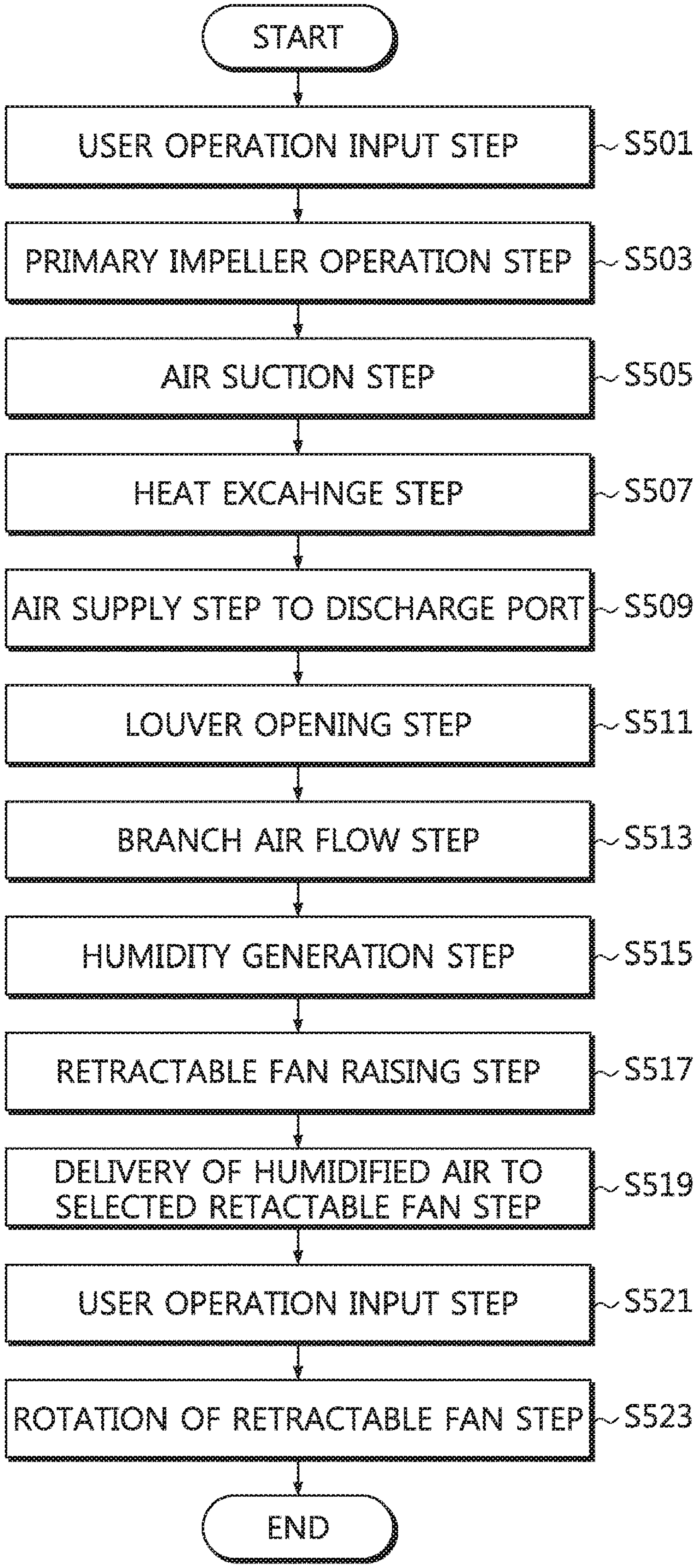

START
USER OPERATION INPUT STEP
S401
RETRACTABLE FAN RIGING STEP
S403
OPTIONAL PRIMARY IMPELLER & LOUVER OPERATION STEP
S405
OPTIONAL AIR INTAKE STEP
S407
OPTIONAL BRANCH AIR FLOW PASSAGE STEP
S409
HUMIDITY GENERATION STEP
S411
HUMIDITY DELIVERY TO RETRACTABLE FAN STEP
S413
USER OPERATION STEP
S415
ROTATION OF RETRACTABLE FAN STEP
S417
END

FIGURE 47


START
USER OPERATION INPUT STEP
S501
PRIMARY IMPELLER OPERATION STEP
S503
AIR SUCTION STEP
S505
HEAT EXCAHNGE STEP
S507
AIR SUPPLY STEP TO DISCHARGE PORT
S509
LOUVER OPENING STEP
S511
BRANCH AIR FLOW STEP
S513
HUMIDITY GENERATION STEP
S515
RETRACTABLE FAN RAISING STEP
S517
DELIVERY OF HUMIDIFIED AIR TO SELECTED RETACTABLE FAN STEP
S519
USER OPERATION INPUT STEP
S521
ROTATION OF RETRACTABLE FAN STEP
S523
END

AIR MANAGEMENT APPARATUS OR DEVICE

CROSS-REFERENCE TO RELATED APPLICATION(S)

This application claims priority under 35 U.S.C. § 119 to Korean Application Nos. 10-2019-0163424, 10-2019-0163426, 10-2019-0163428, 10-2019-0163430, 10-2019-0163431, 10-2019-0163432, 10-2019-0163437, 10-2019-0163438, 10-2019-0163441, 10-2019-0163444, all filed on Dec. 10, 2019, and Korean Application No. 10-2019-0168728 filed on Dec. 17, 2019, whose entire disclosure(s) is/are hereby incorporated by reference.

BACKGROUND

1. Field

The present invention relates to an air management apparatus, and more particularly, to an air management apparatus or device to be placed over a floor of a livable space and discharges air to the surrounding environment of the livable space.

2. Background

The air management device may maintain the air in a predetermined space in a desired state or temperature to provide a pleasant environment for those in the space. An example may an air conditioner. Various types of air conditioners may be used. The air conditioner may include an indoor unit provided in the same position as the window and the outdoor unit provided outside. In another type, the indoor unit may be installed on the ceiling of a corresponding space, a stand type installed in an indoor space, or a wall type installed on an upper wall of an indoor space.

Other than the window type, the indoor unit are configured to discharge air into the room at a higher position of the indoor space. Therefore, it is difficult to perform air conditioning in accordance with the needs of individual users quickly and accurately. In the case of the window type air conditioner, there is generally one discharge port, and it may be difficult to perform air conditioning in accordance with the needs of individual users.

Recently, livable spaces, e.g., as living rooms, bedrooms, rooms, kitchens, and study rooms, may be connected, and the demand for products that may maximize the efficiency and functionality of the livable space is increasing. As the trend of integration of livable space and the trend of nuclear family overlap, demand for various home appliances are increasing. Air management system is a type of home appliances that can maintain the temperature, humidity, cleanliness, etc. in the livable space and may fulfil the trend. Further, there may be a need for the air management device to harmonize with other elements in the livable space. However, the conventional air conditioner inadequately harmonizes with other elements in the living space.

Korean Publication Nos. 10-2005-0023790 and 10-2015-0082967 and Korean Patent No. 10-2009-0038555 attempt to solve various problems, but are insufficient to disperse the discharged air or meet the needs of the user or multiple users in the livable space. Other than the window type, the indoor unit All the air conditioners except the window type are configured to discharge air into the room at a higher position of the indoor space. Therefore, it is difficult to perform air conditioning in accordance with the needs of individual users more quickly and accurately. In the case of the window type air conditioner, there is generally one discharge port, and thus it is may be difficult to perform air conditioning in accordance with the needs of individual users. Korean Publication Nos. 10-2005-0023790 and 10-2015-0082967 and Korean Patent No. 10-2009-0038555 attempt to solve various problems, but are insufficient to disperse the discharged air or meet the needs of the user or multiple users in the livable space, the trend, and harmonization with other elements.

The above references are incorporated by reference herein where appropriate for appropriate teachings of additional or alternative details, features and/or technical background.

SUMMARY OF THE INVENTION

According to the disclosed embodiment(s), the air management apparatus may be seated on the floor of the livable space in which is the ambient air is sucked in to be heat exchanged to a desired temperature, and is discharged through a plurality of discharge ports. Because the discharge ports are arranged side by side and the air discharge is independently controlled, air management can be performed to meet the needs of the users who may be located in front of a housing of the air management apparatus in left and right directions.

The air discharged by the primary impellers may be guided the air to the primary impeller outlets at a position corresponding to the discharge port, and it is possible to discharge the heat exchanged air stably through each discharge port.

The louver motors for opening or closing of the louvers provided for the discharge ports may be independently driven for precise control of air charge or air dispersal.

Due to the motor block to install the louver motors, the primary impeller guide may be easily installed regardless of the motor type.

The pivot axis for the louver is provided along a longitudinal central axis of the louver using a pivot brackets having a hole, and opening or closing of the louver may be shared or easily controlled.

A primary impeller guide of a heat insulating material may include a plurality of primary impeller openings corresponding to the number of the discharge port and are formed side by side. A plurality of primary impellers are formed in the openings to allow customization of air delivery to side-by-side located users in front of the housing.

In the disclosed embodiment(s), a branch air flow may be formed at least one of a plurality of primary impeller openings to divert air to at least one retractable fan or pop-up fan allow discharge of air further and to other regions of the livable space.

In the disclosed embodiment(s), at least one retractable fan or pop-up fan protrudes above the upper surface of the housing to send the air to a position farther than at least one discharge ports provided in the front of the housing.

In the disclosed embodiment(s), each primary impeller may be independently driven to meet the needs of various users in front of the housing with the air discharged through the respective discharge ports.

The louver installed in each discharge port to open or close the discharge port and the opened angle of each louver may be independently controlled to adjust the vertical and horizontal angles of the air discharged from the discharge port to the user to allow direct or indirect delivery of air.

In the disclosed embodiment(s), humidity may be added to the air to provide a comfortable and/or healthy environment to the livable space.

In the disclosed embodiment(s), a replaceable filter may be installed at a position past the bottom inlet formed in the bottom plate of the housing, and the replaceable filter may be pulled in and out through the entrance of the front lower portion of the housing to facilitate the maintenance and removal.

In the present embodiment(s), one side end of the housing may be partitioned to form a first space for the first retractable or pop-up fan and/or a humidifier, the other end of the housing may be partitioned to formed a second space for a machine room and/or a second retractable or pop-up fan to provide more flexibility of various operation modes.

In the present embodiment(s), the upper surface of the housing is formed with a flat top plate for placement of various items to allow efficient usage of space the air management apparatus or device.

According to another feature of the present embodiment(s), the housing of the air management apparatus or device imitates a household furnishing, and houses a heat exchanger to supply the heat exchanged air into the living space. According to such a configuration, the air management apparatus may perform air management of the living space while being in harmony with the surroundings.

In the present embodiment(s), a thermal imaging camera may be provided to detect the user's body temperature in the front of the housing, and using the information obtained from the thermal imaging camera to perform the air management to suit the user.

BRIEF DESCRIPTION OF THE DRAWINGS

The embodiments will be described in detail with reference to the following drawings in which like reference numerals refer to like elements wherein:

FIG. **1** is a perspective view showing an embodiment of the air management apparatus;

FIG. **2** is a top plan view showing the inside of the air management device shown in FIG. **1**;

FIG. **3**A is a front perspective view showing the configuration of various part of the housing for the air management device shown in FIG. **1**;

FIG. **3**B is a rear perspective view of FIG. **1**;

FIG. **4** is a cross-sectional view taken along the line D**4**-D4 of FIG. **1**;

FIG. **5** is a cross-sectional view taken along the line D**5**-D5 of FIG. **3**;

FIG. **6** is a perspective view showing the configuration of a primary impeller guide used in the air management device shown in FIG. **4**;

FIG. **7** is a perspective view illustrating that primary impellers located in the primary impeller guide shown in FIG. **6**;

FIG. **8** is an exploded perspective view showing a configuration for discharging air through the discharge port in the front of the housing;

FIG. **9** is a perspective view showing the configuration of a louver;

FIG. **10** is a cross-sectional view taken along the line D**10**-D**10** of FIG. **1**;

FIG. **11** is a perspective view showing the first inner frame and various components;

FIG. **12** is a perspective view of the first inner frame **202** shown in FIG. **11** independently;

FIG. **13** is an exploded perspective view of various components for a retractable or pop-up fan;

FIG. **14** is a different perspective view showing the lift platform shown in FIG. **13**;

FIG. **15** is a sectional view taken along the line D**15**-D**15** in FIG. **1**;

FIG. **16** is a side cross-sectional view illustrating lifting and rotation of a retractable or pop-up duct;

FIG. **17** is a perspective view of a replaceable filter;

FIG. **18** is an exploded perspective view of the drawer type replaceable filter;

FIG. **19** is a sectional view of various components for the drawer type replaceable filter;

FIG. **20** is a perspective view showing an example of the rail assembly used for the drawer type replaceable filter;

FIG. **21** is a bottom view of the air management apparatus;

FIG. **22** is a perspective view a filter cleaner;

FIG. **23** is a side view showing a state in which the elastic bristles of the filter cleaner in contact with the filter;

FIG. **24** is a perspective view of a humidifier for humidification used in the embodiment;

FIG. **25** is a perspective view of the configuration shown in FIG. **24** viewed from another direction;

FIG. **26** is a perspective view showing the configuration of a bucket seat;

FIG. **27** is an exploded perspective view of the bucket seat shown in FIG. **26**;

FIG. **28** is an exploded perspective view showing a configuration for guiding the tilt table to be tilted with respect to the base of the configuration shown in FIG. **26**;

FIG. **29** is a cross-sectional view showing a configuration for guiding the tilt table to be tilted with respect to the base;

FIG. **30**A is a cross-sectional view taken along the line D**30**-D30 in FIG. **2**;

FIG. **30**B is perspective view of the machine room **500**;

FIG. **30**C is a sectional view of the machine room **500**;

FIG. **30**D is a perspective view of the second inner frame **202'**;

FIG. **31** is a perspective view of a drain pump;

FIG. **32** illustrates an operational air flow through the heat exchanger and discharged through the louver;

FIG. **33** illustrates an operational air flow discharged simultaneously through the first to the third discharge port;

FIG. **34** illustrates the pop-up duct used to protrude from the housing;

FIG. **35** is a view showing an operation state in which a discharge port is opened and pop-up ducts on both sides protrude to discharge air;

FIG. **36** is an operational state diagram showing a state in which the replaceable filter withdrawn from the housing;

FIG. **37** is an operation state illustrating the humidified air being discharged through a pop-up duct;

FIG. **38** is a use state in which the first movable panel is opened and the tilt table is inclined to expose the bucket;

FIG. **39** is an operating state showing the tilt table tilted;

FIG. **40** is an operational state diagram showing the tilt table being driven in an inclined state;

FIG. **41** is a sectional view D**30** shown in FIG. **2**;

FIG. **42** is a block diagram of an air management device;

FIG. **43** is a flowchart illustrating a control method of an air management apparatus according to an embodiment;

FIG. **44** is a flowchart illustrating a control method of an air management device according to another embodiment; and

FIGS. **45** to **47** is a flow chart showing a control method of the air management device according to other embodiments.

DETAILED DESCRIPTION

As shown FIGS. **1**-**3**B, the housing **10** provides an outer appearance of the air management device and may have a hexahedron shape extending from side to side. The lower surface of the housing **10** faces the floor of the living space, and the rear surface of the housing **10** faces the wall of the living space. The upper surface of the housing **10** may have a rectangular shape of a predetermined surface area. The upper surface of the housing **10** may be located at a height such that a person may look down on the upper surface while standing up. The housing **10** may have a width from side to side which is at least two times the height, and the height may be greater than the front to back lengths of the upper surface. For example, the width may be 2000 mm (approximately 79 inches), the front-back length may be 450 mm (approximately 18 inches), and the height may be 600 mm (approximately 24 inches).

The bottom plate **11** provides a bottom of the housing **10**. The bottom plate **11** may have a rectangular shape and is positioned at a predetermined distance above a floor of a livable space. Side plates **12** are attached on both sides of the bottom plate **11** to provide the side surfaces of the housing **10**. A top plate **14** may provide an upper surface of the housing **10**. The upper surface of the top plate may provide a flat planar surface to allow placement of various articles and/or electronics. As can be appreciated, the placement of articles and/or electronics may be restricted to prevent interference with retractable first and second fans **200**, **200'** (or first and second pop-up fans **200**, **200'**) described below.

A back plate **13** provides a rear surface of the housing **10**. The back plate **13** may be provide at a rear of the bottom plate **11**, the side plates **12** and the top plate **14**. However, as shown in FIGS. **2**, the back place **13** is attached a predetermined distance from the rear ends of the bottom plate **11**, the side plates **12** and the top plate **14** such that a predetermine gap exists between the back plate **13** and the wall of the livable space. When the housing **10** is installed in the livable space, a rear space **13***s* is may be between a rear surface of the back plate **13** and the wall surface. The back plate may further include first and second holes **13'***a* and **13'***b* through which a discharge pipe **506** and a gas supply hose **510** may pass therethrough, which is described in FIGS. **30**A-**30**C. A pair of third holes **13'***c* allows passage for a connection duct **413** of a humidifier described below. Through hole **13"** allow passage of adjacent inlet and outlet pipes of a heat exchanger **104**. Reference numeral **29** is a through hole formed in the second partition plate **19'** for the gas supply hose **510**. These holes **13'***a*, **13'***b* and **29** are formed slightly larger than the diameter of the corresponding hoses **506** and **510**.

A power supply hole **26** may be provided to have a size corresponding to the size of a wall outlet **516** (FIG. **30**C), and may have a size larger than the through hole **13"**. The power supply hole **26** is formed at an upper end of the rear plate **13** corresponding to the rear surface of the second secondary space **24**. The power supply hole **26** allows passage of the power cord **512** to the wall outlet **516**. The power supply **26** also allows the user to access the outlet **514** on the wall to perform engagement and separation of the power cord **512** and the outlet **514**. The size of the power supply hole **26** may be at least larger than the front area of the outlet **514**. The size of the power supply hole **26** may be such that the outlet **514** can be easily seen by the user through the rear space **13'** and the power cord **512** can be manually connected. The through hole **13"** may be smaller than the power supply hole **26**.

The front plate **15** may provide a front surface of the housing **10**. The front plate **15** may not provide the entire front surface of the housing **10**, but may be provided along a position corresponding to a primary air flow space **20** described below. First, second and third discharge ports **15'-1**, **15'-2**, and **15'-3** in a side-by-side configuration may be formed at the upper end of the front plate **15**. The discharge ports **15'-1**, **15'-2**, and **15'-3** have a rectangular shape, which may correspond to the shape of the housing **10**.

An input unit **17**, e.g., a user interface, through which a user's may be received may provide along a front of the housing **10**. For example, the input unit **17** may be formed on the front lower end of the housing **10**, but as can be appreciated, the position at which the input unit **17** may be place is not limited to the lower end. For example, it may be formed as part of the front plate **15** of the housing **10**. The input unit **17** may be formed so that a part of the user's input is displayed on the outside, and the remaining components may be formed in the inner space.

The input unit **17** may receive a user's input for the overall operation of the air management device of the present disclosure. Thus, the user can input the ON/OFF of the air management device, the temperature of the discharged air, the air volume, the wind direction, and a user operation for the operation of various components described later through the input unit **17**. The input unit **17** may comprise a push button, a touch input and/or a display.

The input unit **17** may be implemented in the form of a button or a touch pad. As can be appreciated, the input unit **17** may be implemented in the form of a touch screen on the display. In another embodiment, the input unit **17** and the display may be integrally implemented. A touch panel may be formed on the display to receive a manipulation input of a user through touch.

The display may also include a flat panel display. The display may display a user interface (UI) or a graphic user interface (GUI) related to driving and operation of the air management apparatus. The display may be, e.g., a liquid crystal display, a thin film transistor-liquid crystal display, an organic light-emitting diode, a flexible display, a three-dimensional display 3D display). When the display and the touch sensor for detecting the touch operation form a mutual layer structure to form a touch screen, the display may be used as an input device in addition to the output device. The touch sensor may have, for example, a form of a touch film, a touch sheet, a touch pad, or the like.

In one embodiment, the user may directly touch the input unit **17** to input a user operation. Alternatively, or in addition thereto, the input unit **17** may receive a user manipulation input through a wireless signal of an external device. The input unit **17** may include a wireless communication module for performing wireless communication with the external device. The wireless communication may be based on infrared (IR) protocol, near field communication (NFC) protocol, Wi-Fi protocol, Bluetooth protocol, Zigbee protocol, BLE (Bluetooth Low Energy) protocol, telecommunication protocol, e.g., LTE or 5G, and/or other wireless communication protocol. Alternatively, or in addition thereto, a remote controller may be used to allow a user's manipulation to be received through infrared communication.

At least four corners of the housing **10**, legs **18** of predetermined height to allow a lower surface of the bottom plate **11** to be a predetermined distance from a floor or bottom surface of the living space. Further, the legs **18** may create a space in which air can be sucked into a bottom inlet **11'** formed in the bottom plate **11**. As can be appreciated, additional legs **18** may be provided based on, e.g., the side-to-side length of the housing **10**.

The outer surfaces of the side plate **12**, the top plate **14**, the front plate **15**, the first movable panel or plate **16**, and a second movable panel or plate **16'** of the housing **10** may be made of a material to provide an aesthetically appealing appearance. The outer surface of the housing **10** may be formed to have an appearance of a household furniture. For example, the material surface of the housing **10** may have an appearance of a wood material, a varnished finish or coated finish.

The interior of the housing **10** may be divided into three spaces, where a first partition wall **19** separates the primary air flow space **20** and a first secondary space **22** and a second partition wall **19'** separates the primary air flow space **20** and a second secondary space **24**. Within the primary air flow space **20**, the air in the livable space is forced through the bottom inlet **11'** to be heat exchanged, and exhausted through the first, second and third discharge ports **15'-1**, **15'-2**, **15'-3** into the livable space. The first retractable fan or first pop-up fan **200** and the humidifier **400** may be installed within the first secondary space **22**, and a machine room **500** and the second retractable fan or second pop-up fan **200'** may be installed in the second secondary space **24**. The left and right width of the primary air flow space **20** may be at least two times greater than the left and right widths of the first secondary space **22** and the second secondary space **24**. The left and right width of the primary air flow space **20** may be dependent upon the number of discharge ports **15'-1**, **15'-2**, **15'-3**, . . . **15'-*n*** to be formed in the front plate **15** of the housing **10**.

Access to the first and second space **22**, **24** may be made through the first and second moveable panels **16**, **16'**. The first and second movable panels **16**, **16'** may be installed on the remaining front of the housing **10** not covered by the front plate **15**. The first and second movable panels **16**, **16'** may be configured as slidable access panels or plates. See FIG. **38**. Alternatively, the first and second movable panels may be configured to be hinged, similar doors, to open or close the first secondary space **22** and the second secondary space **24**.

As shown in FIG. **4**, a heating, ventilation and air conditioning (HVAC) system **100** may be installed in the primary air flow space **20** and may be configured to exchange heat with air drawn through the bottom inlet **11'**. Thereafter, the suctioned air may discharge to the first, second, and third discharge ports **15'-1**, **15'-2**, **15'-3**. A replaceable filter **300** may be placed at a position corresponding to the bottom inlet **11'**. Air passing through the replaceable filter **300** flows through the air passage **102** formed in the primary air flow space **20**.

A heat exchanger **104** may be provided in the air flow path **102**. The heat exchanger **104** may allow a heat exchange between the air flowing in the air flow path **102** and the working fluid of the heat exchange cycle. For example, in the case of a cooling operation, the heat exchanger **104** may receive heat from the air and may transfer the heat to the outdoor unit for discharge to the outside. In the heating operation, the heat may be transferred from the working fluid while the air passes through the heat exchanger **104** to be transferred into the living space. Of course, in the heating operation, the heat may be supplied from a separate configuration without using the heat exchanger **104**. The working fluid delivered from the outdoor unit is delivered to the heat exchanger **104** through the inlet pipe, and the working fluid passed through the heat exchanger **104** is delivered to the outdoor unit through the outlet pipe. A drain pan **108** may be provided under the heat exchanger **104**. The drain pan **108** collects and discharges condensed liquid condensed from the air passing through the heat exchanger **104**.

In order to form the air passage **102**, the primary air flow space **20** may include components for guiding the flow of air. There may be an inlet guide **110** to face the replaceable filter **300**. The inlet guide **110** may be provided over a region corresponding to the inlet **11'**. The inlet guide **110** may face most of the region or area of the bottom inlet **11'**. An angled guide surface **110'** may formed in the inlet guide **110** so that air passing through the inlet **11'** region adjacent to the front end of the housing **10** may be directed or guided to the back plate **13**. The slope of the angled guide surface **110'** moves away from the bottom inlet **11'** toward the rear plate **13** such that a clearance over the replaceable filter **300** may increase from the front to the rear of the replaceable filter **300**.

The air inlet guide **110** may extend toward the rear plate **13**, and the air inlet guide **110** may extend about ⅔ of the bottom inlet **11'**. As such, the air inlet guide **110** may allow majority of the suctioned air to be delivered to the rear of the air passage **102** inside the housing **10**. The drain pan **108** and a primary impeller guide **120** may be located over an upper surface of the inlet guide **110**, which is opposite of the angled guide surface **110'**.

The air passage **102** may include an upper guide **112**. The upper guide **112** may serve as a ceiling or a top cover of the air flow path **102**. The upper guide **112** extends from the back plate **13** to the primary impeller guide **120**. The upper guide **112** has a curved surface to prevent formation of a vortex or air turbulence at the portion that meets or connects to the rear plate **13**. In other words, the back plate **13** and the upper guide **112** may not be perpendicular to each other. Further, a portion of the inner surface of the rear plate **13** corresponding to the air flow path **102** may be curved. The back plate **13** and the upper guide **112** is to be a continuous curved surface rather than abrupt coupling joints. To accomplish such curved surface, the rear surface of the rear plate **13** may be formed to protrude or curve to the outside.

The inlet guide **110** and the upper guide **112** may be made of a heat insulating material or the surfaces of thereof may be coated with a heat insulating material. The heat insulating material may prevent a heat exchange with the surroundings. The upper guide **112** may contact the upper end of the heat exchanger **104** and may extend to the primary impeller guide **120**.

As illustrated in FIGS. **6-8**, the primary impeller guide **120** is installed in front of the heat exchanger **104**. The primary impeller guide **120** may guide air to be sucked into the air flow passage **102** and discharged to the indoor space through the discharge ports **15'-1**, **15'-2**, **15'-3**. Primary impellers **131**, **131'** and **131"** with primary impeller blades **130**, **130'** and **130"** and primary motors **132**, **132'** and **132"** may be positioned therein. By dividing the air flow into, e.g., three paths, the primary impeller guide **120** separates the air passing through the heat exchanger **104**. The primary impeller guide **120** may be made of a thermal insulation material to ensure that the heat-exchanged air passed through the heat exchanger **104** can be delivered to the livable space with minimal heat loss rather than being dissipated inside the housing **10**.

A primary impeller frame **122** may be formed of or coated with a thermal insulation material, and serve as the skeleton of the primary impeller guide **120**. The primary impeller frame **122** may have a predetermined thickness in the front-rear direction, and a plurality of primary impeller openings **124**, **124'**, and **124"** may formed therein. As shown in FIG. **7**, the first, second and third primary impellers **131**, **131'**, **131"** may be respectively installed in the first, second, third primary impeller openings **124**, **124'**, and **124"** to allow rotation of the first, second, and third primary impeller blades **130**, **130'**, **130"**. The axial centers of the primary impellers may be equal distant from each other or may be different.

The primary impeller openings **124**, **124'**, and **124"** face the heat exchanger **104** to form the primary impeller inlet **126** for the primary impellers. However, only a portion of the primary impeller openings **124**, **124'**, **124"** may be open to serve as the primary impeller outlets **128**, corresponding to the discharge ports **15'-1**, **15'-2**, **15'-3**. In other words, the primary impeller outlets **128** may be formed at a position corresponding to the upper side at primary impeller openings **124**, **124'** and **124"**, corresponding to the positions of the first to third discharge ports **15'-1**, **15'-2**, and **15'-3** of the front plate **15**. Hence, the cross-sectional area of the primary impeller outlets **128** may be smaller than the cross-sectional area of the primary impeller openings **124**, **124'** and **124"** or the primary impeller inlets **126**. The primary impeller outlets **128** may be provided at an upper end of the openings **124**, **124'** and **124"**. Alternatively, the primary impeller outlets may be provided at the middle or lower section of the openings **124**, **124'** and **124"** depending on the position of the first to third discharge ports **15'-1**, **15'-2**, **15'-3**.

A branch air flow channel or passage **129**, e.g., a duct, a passageway, conduit, tunnel, etc., may be formed in the primary impeller frame **122** at one side of an inner surface defining the first primary impeller opening **124** and/or the third primary impeller opening **124"**. A portion of the air flowing through the first primary impeller opening **124** and/or the third primary impeller opening **124"** may be diverted to the first and/or second retractable fans **200**, **200'**. The branch passage **129** may be open (e.g., an outlet) on both sides of the impeller frame **122** to transfer the diverted air to the first secondary space **22** and/or the second secondary space **24**.

As shown in FIG. **7**, the primary impellers **131**, **131'**, and **131"** are installed in the first, second and third primary impeller openings **124**, **124'**, and **124"**, respectively. The first, second and third primary impeller blades **130**, **130'**, **130"** are rotated by the first, second and third primary impeller motors **132**, **132'**, **132"**, respectively, to provide a driving force for the air flow. The impeller motors **132-132"** may be controlled by a controller **600** (FIG. **42**). In the present embodiment, the controller **600** may operate the primary impellers **131-131"** to operate simultaneously or independently from each other. Although three (3) primary impellers **131-131"** are illustrated, additional impellers may be provided, e.g., additional primary impellers for each of the primary impeller openings and/or additional impellers based on the number of primary impeller openings. Further, although the primary impellers may have the same size and/or the same cubic feet per minute (CFM) for air flow, different sizes or CFM may be used, and/or the size of primary impeller openings may vary. Depending on the location of the primary impeller inlet and outlet, an appropriate fan type may be use. In this embodiment, a turbo fan in which air is drawn in the rotational axis direction and discharged in the centrifugal direction may be used.

In the present embodiment, three (3) dampers, e.g., louvers **141**, **142**, **143**, may be positioned corresponding to the three primary impellers **131**, **131'**, **131"**. For example, a first louver **141** may be installed in the first discharge port **15'-1**, a second louver **142** may be installed at the second discharge port **15'-2**, and a third louver **143** may be installed at the third discharge port **15'-3**. The louvers **141**, **142**, **143** may be simultaneously or independently driven by the same driving source or by separate driving sources, respectively, to open and close the discharge ports **15'-1**, **15'-2**, **15'-3**, and to discharge the air. Further, the degree of opening of the discharge ports **15'-1**, **15'-2**, **15'-3** may be same or different. As can be appreciated, the number of dampers may be changed based on aesthetics of the housing, the number and/or size of the primary impeller openings, and/or the number or size of primary impellers in each primary impeller opening.

Opening or closing the louvers **141**, **142**, **143** may be performed by louver motors **141'**, **142'**, **143'**. The output shafts of the louver motors **141'**, **142'**, and **143'** are connected to the rotational axes of the louvers **141**, **142** and **143** so that the louvers **141**, **142** and **143** are rotated when the output shafts are rotated. The louver motors **141'**, **142'**, and **143'** may be driven and/or controlled by the controller **600** to open or close the discharge ports **15'-1**, **15'-2**, **15'-3**. The louver motors **141'**, **142'**, **143'** may also adjust the opening angles of the louvers **141**, **142**, **143**.

As shown in FIG. **9**, a pair of pivot brackets **145** may be attached or formed on each rear surface of the louvers **141**, **142**, **143**. A pivot axis hole **145'** may formed in each pivot bracket **145**. An output shaft of each louver motor **141'**, **142'**, **143'** may be coupled to one of the pivot axis hole **145'**. Although the pivot bracket **145** may have a wedge or triangular shape, other shapes may be used. Further, as can be appreciated, the pair of pivot brackets **145** may not be required to be located along the central longitudinal axis of each louvre. Alternatively, or in addition thereto, the louvre may be configured to slide, e.g., up and down, to open and close the primary impeller outlet **128**.

The louvre motors **141'**, **142'**, and **143'** may be fixed to the installation groove **150** formed in the primary impeller guide **120** using a motor block **146**. One side of the motor block **146** coupled to the louvre motors **141'**, **142'**,**143'** has a shape based on the exterior contour of the louvre motors **141'**, **142'**, and **143'**, and the other side of the motor block **146** is inserted and coupled to the installation groove **150**.

Each of the louvers **141**, **142**, **143** may include the pair of pivot brackets **145**, each bracket having a pivoting hole **145'**. One of the pivoting hole is coupled to a shaft of a corresponding louvre motor **141'**, **142'**, or **143'** and the other pivoting hole is coupled to a slave shaft or pin **147**. The motor shaft and the slave shaft **147** form a rotation or pivoting axis for the louvers **141**, **142**, and **143**. A pair of support pieces **149**, fixed to the installation groove **150** of the fan guide **120**, supports each end of the slave shaft.

In the illustrated embodiment, the slave shaft may be provided for one of the pair of pivot brackets **145**. However, in certain instances, two adjacent louvers may share the same slave shaft. As shown in FIG. **8**, the second and third louvers **142** and **143** each include a slave shaft **147** and pair of support pieces. Instead, the adjacent pivot brackets of the second and third louvers may share a single slave pin. Alternatively, the slave shafts **147** may be omitted if the shaft of the drive motors **141'**, **142'** or **143"** extends all the way across between the pivot holes **145'** of the pair of pivot brackets **145**.

The particular structure and arrangements of the pivot brackets **145** are not limited to the present disclosure. In this embodiment, the heat exchanged air is exhausted upwards the louvers **141-143** are opened (FIG. **33**), where the maximum opened position of the louvers **141-143** being limited due to the pivot brackets being located along the central longitudinal axis of the louvers. However, a lever or linkage may be provided between the pivot hole **145'** and the motor and slave shafts to allow the louvers **141-143** to be at least perpendicular to the front plate **15**. In such a configuration, heat exchanged air may be exhausted perpendicular to the front plate **15**. Alternatively, the pivot brackets **145** may be provided near the bottom of the louvers **141-143**.

The output shafts of the louvre motors **141'**, **142'**, and **143'** may be operated by setting the speed and torque of the gears therein. The rotational angles of the louvers **141**, **142**, and **143** may be set by the degree of rotation of the output shafts of the louvre motors **141'**, **142'**, and **143'**. The rotational angles of the louvers **141**, **142**, and **143** may be controlled based on the user selection or a preset operational setting.

The impellers (impeller blades **130**, **130'**, **130''** and corresponding impeller motors **132**, **132'**, **132''**) may all be operated simultaneously or independently. The impellers may be operated in various combinations according to the operation mode of the air management device.

For example, all louvers **141**, **142** and **143** may be opened to discharge the heat-exchanged air to the front of the housing **10** when all the impellers may be operated. At this time, the heat exchanged air may be prevented from being supplied to the branch passage **129**, e.g., a secondary flow path, by closing a first damper **206** (FIG. **10**). The first damper **206** is opened or closed by an operation of a damper driving motor, which is controlled by the controller **600**. Alternatively, only one or two of the impellers may be turned on with one or two of the respective louvers being opened, while the first damper **206** is closed to prevent heat exchanged air from being supplied to the branch passage **129**.

The suctioned air may be supplied to the additional retractable first or second fan **200**, **200'** in a state in which at least one of the louvers **141**, **142**, and **143** are closed. For example, when all the louvers **141-143** are closed, a primary first impeller **131** (primary first impeller blade **130** and primary first impeller motor **132**) and the primary third impeller **131''**(primary third impeller blade **130''** and primary third impeller motor **132''**) may be turned on and the first damper **206**may be opened, the suctioned air flows through the secondary flow passage **129**. Alternatively, the three primary impellers **131**, **131'**, **131''** may be turned on with the louvers **141** and **143** closed and the damper **206**and louvers **142** opened, the heat exchanged air may be supplied to the secondary flow passage and also discharged through the middle of the housing **10**.

As shown in FIGS. **1** and **2**, the discharge units or retractable fan **200** or **200'** may be provided on either side of the upper surface of the housing **10**. The retractable fans **200**, **200'** may allow first and second retractable ducts **234**, **234'** (or first and second pop-up ducts) to protrude from the upper surface of the housing **10** to further disperse the heat-exchanged air to a wider area.

As illustrated in FIGS. **10-16**, the first and second retractable fans **200**, **200'** may be installed on at least one of the first secondary space **22** and/or the second secondary space **24** of the housing **10**. Although the drawings illustrate the first and second retractable fans **200**, **200'** installed in the first secondary space **22** and the second secondary space **24**, a detailed description of first retractable fan **200** installed in the first secondary space **22** is provided. Based on similar configuration, one of ordinary skill in the art may readily understand the installation of the second retractable fan **200'** in the second secondary space **24**.

As shown in FIGS. **10-12**, a first inner frame **202** may partition the first secondary space **22** to form an first inner space **203** and a first vertical duct **208**, which are adjacent to each other and allows installation of the first retractable fan**200** and the humidifier **400**, respectively. The first inner space **203** may be accessed through the first movable panel **16**, which slides left and right with respect to the housing **10** to open or close the first inner space **203**.

A connection duct **204** is installed on the right side of the first inner frame **202**. The first connection duct **204** is bent to have a reverse 'L' shape (or "L" shape on the other side), where the inlet communicates with the branch passage **129** of the fan guide **120** and the outlet communicates with the first vertical duct **208**. A first connection flow passage **205** is provided at the inlet of the first connection duct **204**, where the first connection flow passage is opened or closed by the first damper **206**. Although the first connection duct **204** is shown to have a bent shape, other shapes and configurations are possible in view of the present disclosure and knowledge to one of ordinary skill in the art.

As shown in FIGS. **13-16**, the first vertical duct **208** extends in the vertical direction to guide the lifting and lowering of a first lifting box or lift platform **214** such that the retractable first duct **234** of the first retractable fan **200** may move along a predetermined trajectory. When the first retractable fan **200** is raised, a first vertical flow path **210** is form inside the first vertical duct **208** between the outlet of the first connection duct **204** and an inlet of the retractable first duct **234**. The vertical duct **208** does not necessarily need to be formed in the first inner frame **202** and may be made separately installed in the first secondary space **22**. The vertical duct **208** extends in the vertical direction to guide the lifting and lowering of the lifting box **214** to be described below so that the popup duct **234** can be lifted along a predetermined trajectory.

A first lift platform **214** of the retractable first duct **234** may vertically move inside the vertical duct **208** using a first lift gear **212** (e.g., a linear gear) and a second lift gear **232** (a circular gear, e.g., a pinion) driven by a first lift motor **230**. The first lift gear **212** may be a vertical rack formed from top to bottom of the first vertical duct **208**. The cross-sectional shape of the first lift platform **214** may be the same as the cross sectional shape of the first vertical duct **208** except for a first indentation **221**. The outer surfaces of the lift platform **214** may move in contact with the inner surface of the first vertical duct **208**.

As shown in FIG. **14**, a first support ring **216** of a cylindrical shape passes through the first lift platform **214** to create a first communication passage **218**. A first support base **238** is inserted into the first support ring **216** to be rotatably supported therein. The first communication channel **218** allows passage of air from the vertical flow path **210** to a retractable or pop-up channel **236** of the retractable first duct **234**. The first support ring **216** is rotatably fitted with the first support **238** at the lower end of the retractable first duct **234**.

A first impeller support **219** having two beams crossing each other may be provided inside the communication passage **218**. A first secondary impeller blade **224** driven by an impeller motor (not shown) may be mounted to the first impeller support to pressurize the air discharged from the first retractable fan**200**. The impeller motor may be driven or controlled by the controller **600**.

A rotary motor housing **220** formed of a ring shape may be provided adjacent to the first support ring **216** of the first lift platform **214** and may be configured to receive a rotary motor **226**. The first indentation **221** may be provided on one outer surface of the first lift platform **214**, and as shown in FIG. **14**, an elevating motor housing **222** may formed at the indentation **221**. The outer side surface of the first lift platform **214** may be optimized to have the largest possible surface to contact an inner side surface of the first vertical duct **208**.

As shown in FIG. **10**, the first secondary impeller blade **224** is installed in the first impeller support **219** of the first lift platform **214**. The operation of the first secondary impeller blade **224** pressurizes the air in the communication passage **218** to allow the air to be further force the air through retractable first channel **236**. In other words, the air drawn into the first connection duct **204** and the first vertical duct **208** by the impeller, e.g., the first impeller **131**, may be further pressurize by the first secondary impeller blade **224** for travel through the retractable first channel **236**.

A lift motor **230** may be mounted at the elevation motor housing **222** of the first lift platform **214**. The second lift gear **232** may be installed on an output shaft of the lift motor **230** to engaged with the first lift gear **212**. Due to engagement of the second lift gear **232** with the first lift gear **212**, the retractable first duct **324** coupled to the first lift platform **214** of the retractable fan **200** may ascend above or descend below the upper plate **14** of the housing **10** based on the operation of the lift motor **230**, which may be controlled or driven by the controller **600**. The retractable first duct **234** may be cylindrical as shown in this embodiment. However, the retractable first duct **234** may have other various shapes, e.g., a hexahedron shape.

The retractable first duct **234** forms the retractable first channel **236**, which is in communication with the first communication passage **218**. The first support base **238** of the retractable first duct is inserted into the first support ring **216** of the first lift platform **214**. The outer diameter of the first support base **238** may be equal to or slightly smaller than the inner diameter of the first support ring **216** to allow rotation of the first support base **238** relative to the first support ring **216**.

A rotary motor **226** may be mounted to the rotary motor housing **220**. An output shaft of the rotary motor **226** has a first rotary gear **228**, e.g., a pinion. A second rotary gear **240**, e.g., a rack, may be formed around the outer surface of the first support base **238**, which engages with the first rotary gear **228**. The retractable first duct **234** rotates, e.g., side-to-side, along a path of the second rotary gear **240** when the first rotary gear **228** is rotated by the rotary motor **226**. The rotary motor **226** is driven or controlled by the controller **600**.

A plurality of discharge vents **242** may be formed on a section of an outer surface of the retractable first duct **234**. To allow forced discharge of the air flowing through the retractable first channel **236**, an area where discharge vents **242** is formed may be less than half the outer surface of the retractable first duct **234**. Further, the discharge vents **242** may be formed over an area less than **180** degrees with respect to the center of the retractable first channel **236**.

A plurality of first directional blades **244** may be stacked vertically inside the retractable first channel **236**. The directional blades **244** may pivot along a horizontal axis to adjust the vertical direction of the air discharged through the discharge vents **242**. The directional blades **244**, as shown in FIG. **13**, may have a semi-circular plate shape, and may be controlled individually or collectively, either manually or automatically. If manually, at least one of the directional blades **244** may include a tab protruding through the discharge vents **242** for a user to grab and orient the directional blades **244**, and if automatically, at least one of the directional blades **244** may be coupled to a motor driven or controlled by the controller **600**.

The second retractable fan **200'** having same or similar configuration may be installed in the second secondary space **24**. FIG. **30** illustrates a second lift platform **214'**, a second support ring **216'**, a second secondary impeller blade **224'** and second duct **234'**. As can be appreciated, the second retractable fan **200'** may be implanted to have corresponding first lift gear, communication passage, impeller support, rotary motor housing, indentation, elevation motor housing, rotary motor, first rotary gear, lift motor, second lift gear, retractable channel, support base, second rotary gear, discharge vents, directional blades, etc.

In the described embodiments, the first retractable fan **200** and/or the second retractable fan **200'** have a cylindrically shaped tower configuration. As can be appreciated, other shapes are possible, e.g., rectangular pillar shape configuration with discharged vents **242** provided on one side, by changing the shape of the retractable first and/or second ducts **234**, **234'**. The shape of the ducts may be determined based on the desire to further distribute or send the heat-exchanged air to a particular location or locations in a room. As can be appreciated, if other shapes are used, the first and/or second support bases **238**, **238'** may be maintained to be cylindrical for the rotation of the retractable first and/or second ducts **234**, **234'**.

In the described embodiment, the discharge vents **242** extend in a vertical direction while the directional blades **244** are stacked vertically. As can be appreciated, the discharged vents **242** may extend horizontally while the directional blades **244** are stacked horizontally to achieve the same or similar results for distributing the air.

A replaceable filter **300** is provided within a push-in/pull-out drawer at a front center of the housing **10**. The replaceable filter **300** is installed at the bottom inlet **11'** provided defined by the bottom plate **11** and purifies/filters the air passing through the bottom inlet **11'**.

As shown in FIG. **3**, the bottom inlet **11'** is formed at the bottom plate **11** located a bottom of the housing **10** and faces the floor on which the housing **10** is placed. When the housing **10** is place on the floor of a livable space, the inlet **11'** is not visible to a user. However, the user is able to access the replaceable filter **300** through the front of the housing **10** by pulling out the housing of the replaceable filter **300** provided at an entrance formed in the lower portion of the front plate **15**. Compare FIGS. **1** and **3**. Based on such a configuration, the replacement of the filter(s) at an end of its life cycle may be simplified.

A filter frame **301**, e.g., a drawer frame, forms a skeleton of the replaceable filter **300**. The filter frame **301** has a hexahedral shape, and a plurality of passage openings **302** are formed on the bottom. Each passage opening **302** is a path through which air is allowed to pass. In the present disclosure, three passage openings **302** are provided having a square shape in a plan view. The shape and size of each passage openings **302** may be based on prevention of a plurality of filters **320**, **330**, and **340** located therein from sagging. A first filter **320**, a second filter **330**, and a third filter **340**, are sequentially stacked over each of passage opening **302**.

A front wall **303** forms a front surface of the filter frame **301**. The front wall **303** forms a partial outer appearance of the housing **10** when the filter frame **301** of the replaceable filter **300** is inserted into the housing **10**. A handle **303'** may be provided at a bottom center of the front wall **303**. A user may grasp the handle **303'** to pull the filter frame through the entrance of the front plate **15** to access the replaceable filter **300**.

A pair of side walls **305** extends rearward from both ends of the front wall **303** and connects to a back wall **307**. The back wall **307** may extend parallel to the front wall **303**. A plurality of filter partition walls **309** connects to the front wall **303** and the rear wall **307** between the pair of side walls **305** to divide the inside of the housing to create the plurality of passage openings **302**.

A seating ledge **311** may extend at a lower end of the side wall **305** and the filter partition wall **309** to provide a seating surface for the edge of the first filter **320**. Alternatively, or in addition thereto, the seating ledge **311** may be formed along a lower end of the front wall **303** and the back wall **307**. As can be appreciated, the surface area of the seating ledge **311** may be based on prevention of narrowing the air flow cross sectional area.

Support ribs **313** are formed at upper and lower ends of the rear wall **307** to protrude to the rear of the filter frame **301**. When the filter frame **301** is withdrawn from the entrance of the front place **15** for replacement filter, the filter frame **301** is supported inside the entrance even though the filter frame **301** is retained in the housing **10** by a rail assembly **350**. The filter frame **301** may be withdrawn all the way to expose the inside surface of the back wall to create a clearance for withdrawal of the filters while the support rib **313** or portion thereof is maintained within the entrance of the housing **10**.

The plurality of filters, e.g., first filter **320**, second filter **330**, and third filter **340** provided over each of the passage opening **302**. The first filter **320** is first installed over the passage opening **302**. The first filter **320** may serve as a pre-filter to filter, e.g., dust. A plurality of the filtering cells **322** in a mesh network may form the first filter **320** and a storage case **324** may be integrally formed, surround the edge of the meshed filtering cells **322** of the first filter **320**.

The rectangular walls of the storage case **324** may create a predetermined storage space **325**. The second filter **330** and a third filter **340** may be stacked inside the storage space **325**. Excluding the first filter **320**, a height of the storage case **324** may be higher than a stacked height of the second and third filters **330**, **340**. As shown in FIGS. **18** and **19**, such an arrangement may facilitate one-step removal of the first, second and third filters **320**, **330**, **340** housed by the storage case **324** from the passage opening **302** of the filter frame **301** when the retractable filter **300** is withdrawn from the entrance of the front plate **15**.

The second filter **330** is installed in the storage space **325**, and the third filer **340** is stacked on top thereof. The second filter **330** has a planar hexahedron shape corresponding to the shape of the storage space **325**. A HEPA filter may be used as the second filter **330**, and the third filter **340** may be a deodorizing filter of activated carbon components.

In order for the filter frame **301** to be pulled out or pushed in of the housing **10**, a rail assembly **350**, e.g., drawer slide set, may be is installed on the sides of the filter frame **301** and corresponding inner surfaces of the housing **10**. See FIG. **20**. The rail assembly **350** includes a first rail **352**, a second rail **356** and a third rail **360**, each rail **352**, **356**, **360** having guide rails at top and bottom, see e.g., guide rails **354** of first rail **352**. The first rail **352** is attached to the side of the filter frame **301** and extends in front-to-rear direction, and the second rail **356** is attached to the inner surface of the housing. The third rail **360** is sandwiched in between the first and second rails **352**, **358**.

Stop rails **354***a*, **354***b* of the first rail **352** prevent the second and third rails **356**, **360** from falling out of the first rail **352** when the filter frame **301** is extended out of or retracted into the housing **10**. A plurality of ball rails **362** are provided at upper and lower ends of the third rail **360**, and a ball bearing **364** is rotatably installed at the ball bearing rails **362** to facilitate movement of the second and third rails **356**, **360**. When the filter frame **301** is pulled out, the first rail **352** moves with the filter frame **301** and the second and third rails **356**, **360** slide along the first rail **352** relatively. The first rail **352** comes to a stop by bumping into an one end of the second rail **356** with the stop rail **354***b*. When the filter frame **302** is pushed in, the first and third rails **352**, **360** slides rearward until the first rail **352** bumps into the other end of the second rail **356** with the stop rail **354***a*, as shown in FIG. **20**.

As shown in FIGS. **4** and **21**, a cleaner **370** configured to remove dust and foreign matter from the first and/or second filters **320** and **330** may be provided under the bottom plate **11** of the housing **10**. The cleaner **370** may be configured to linearly reciprocate along the bottom inlet **11'**. The cleaner **370** may be configured to operate similar to a vacuum cleaner having a suction motor and may optionally include a dust bin and at least one cyclone in a cleaner body **371**. The cleaner **370** is configured and/or positioned to prevent obstruction of the bottom inlet **11'**. This configuration allows the air in the living room to flow smoothly the bottom inlet **11'** and then into the air passage **102**.

As shown in FIG. **22**, the cleaner body **371** forms the appearance and skeleton of the cleaner **370**. A surface **372** of the cleaner body **371** faces the bottom plate **11** and may have a predetermined width in front-to-rear direction which may be at least wider than the width of the bottom inlet **11'**. A suction opening or port **373** may be provided on the surface **372**, which is divided into two by cleaner rail **380** extending therethrough. In an alternative embodiment, a pair of cleaner rails **380** may be provided on the bottom plate **11** at corresponding edges of the bottom inlet **11'** to provide a single suction port **373**. However, when the size of the cleaner **370** increases, the weight may become heavy, so that the size of the cleaner **370** may be reduced by allowing the cleaner rail **380** to cross the suction port **11'**. In addition, when the cleaner suction openings **373** are divided into a plurality, the flow cross-sectional area of each of the cleaner suction openings **373** may be reduced, and the suction force leakage due to the sagging of the cleaner **370** may be prevented.

An air outlet **377** is provided at one side of the outer surface of the cleaner body **371**. The air outlet **377** may be located at a relatively remote position from the cleaner suction opening **373** exhaust air is discharged to the outside after dust or foreign matter is removed from the air sucked into the cleaner suction opening **373**. In such a case, the dust in the air suction into the cleaner suction opening **373** is collected in a dust bin inside the cleaner body **371**. In an alternative embodiment, the dust may be collected in the dust tank at a separate position by connecting the discharge hose to the air outlet **377** without a dust bin inside the cleaner **370**.

The cleaner rail **380** is installed across the bottom inlet **11'** on the bottom surface of the bottom plate **11** to allow the cleaner **370** to linearly reciprocate along the cleaner rail **380**. The cleaner rail **380** may have an "I" beam shape, where the flanges at top and bottom engage grooves from in the cleaner body **371**. Further, a linear gear, e.g., a rack, may be provided between the flanges at the top and bottom of the "I" beam, and may be provided on both sides of the "I" beam.

A motor coupled to a circular gear, e.g., pinion, may be provided in the cleaner body **371**, where the teeth of the pinion engages with the teeth of the rack. Based on the actuation of the motor, the cleaner **370** travels along the cleaner rail **380**, and a number of passes which the cleaner **370** travels across the length of the cleaner rail **380** or across the retractable filter **300**, either in entirety or partially, may be based on a predetermined cleaning cycle determined by the controller **600**.

As shown in FIGS. **22** and **23**, elastic bristles **375** are installed around the edge of the cleaner suction port **373**. The elastic bristles **375** may rub against the surface of the first filter **320** and sweep the dust for entry into the cleaner suction port **373**. The elastic bristles **375** may be arranged to form a wall around the cleaner suction opening **373**. Although a single line of elastic bristles **375** is shown in FIG. **22**, the elastic bristles **375** may be arranged to have a plurality of lines to minimize or eliminate the leakage of suction force. The density of the elastic bristles **375** around the cleaner suction port **373** allows sufficient seal around the edge of the cleaner suction port **373** such that the suction air/force of the cleaner **370** may not leak outside of the cleaner suction port **373**.

The elastic bristles **375** may be made of a material capable of elastic deflection from 0 degrees at the upper end of the elastic bristles **375**, and may have a predetermined diameter and a predetermined length. The elastic bristles **375** may be made of a synthetic material, e.g., plastic, rubber, resin, etc. As can be appreciated, the elastic bristles **375** may be also made of a natural or organic material, e.g., hair, of predetermined stiffness and capable of prescribed degree of elastic deflection. If the length of the elastic bristles **375** is too long relative to the prescribed distance between the first filter **320** and the surface **372**, the middle and bottom end of the elastic bristles **375** may deform to create gaps between the elastic bristles **375**. Such gaps create leakage of air, resulting in reduction of suction force. To prevent such leakage and deformation rather than deflection, the length of the bristles are preselected based on the distance created between the first filter **320** and the surface **372**.

Depending on the weight of cleaner **370** and/or stiffness of the cleaner rail **380**, sagging of the cleaner rail **380** or wobbling of the cleaner **370** on the cleaner rail **380** may occur. However, the elastic bristles **375** may remain in contact with the surface of the first filter **320** due to the elastic deflection, thereby preventing the leakage of suction force. For example, at a location where the cleaner **370** sags due to gravity or wobbles on the cleaner rail **380**, the degree of deflection of the elastic bristles **375** may be less, but ends of the elastic bristles **375** remain in contact with the surface of the first filter **320** to prevent loss of suction force.

Since the replaceable filter **300** is inside the bottom inlet **11'** of the housing **10** and the cleaner **370** is on the bottom plate **11** of the housing **10**, a distance between the bottom surface of the first filter **320** and the surface **372** of the cleaner body **371** may be greater than a distance between a bottom surface of the bottom plate **11** and the surface **372** of the cleaner body. To prevent such a difference in distance, a step may be provided at an edge of the first filter **320** such that the bottom surface of the first filter **320** may be coplanar with bottom surface of the bottom plate **11**. Alternatively, a height of the step may be greater than a thickness of the bottom plate such that the bottom surface of the first filter **320** protrudes closer to the surface **372** of the cleaner **370** than the bottom surface of the bottom plate **11**.

FIGS. **24-29** illustrates a humidifier **400** installed in the first inner space **203**. The humidifier includes an inlet duct **401** penetrating through the first partition wall **19** to communicate with the main air passage **102**. A portion of the air in the main air passage **102** is delivered to the air inlet duct **401**. A inlet fan **403** having an impeller, e.g., circular impeller, is coupled to the inlet duct **401** such that the air in the main air passage **102** is sucked into the air inlet duct **401** when the inlet fan is actuated. Because air flowing into the inlet duct **401** has passed through the replaceable filter **300** (prior to the air being heat exchanged by the heat exchanger **104**), the air delivered to the air inlet duct **401** is in a purified/filtered state.

The pressurized air of the inlet fan **403** is directed through a transfer duct **405** to a steam generator **407**. The steam generator **407** generates steam by heating the water supplied from a bucket **419**, e.g., a liquid storage tank. The steam generator may include a heater to heat the liquid to generate the steam for the humidifier **400**, but water molecules may be vaporized using ultrasonic waves. In other words, different means may be used for generating the steam in the steam generator **407**.

The steam generator **407** includes a first discharge duct **409** to exhaust humified air formed by mixing of the steam generated by the steam generator **407** and the air suctioned through the air inlet duct **401**. The first discharge duct **409** may be connected to first connection passage **205** of the first connection duct **204**. See FIG. **10**. The humidified air flowing through the first discharge duct **409** may be transferred to the first connection duct **204** to flow through the first vertical flow path **210**, the first communication passage **218**, and the retractable first channel **236**, and then expelled through discharge vents **242** when the first retractable fan is raised and activated by the controller **600**.

As illustrated in FIGS. **24** and **25**, the steam generator **407** may include a second discharge duct **411** in a direction different or opposite from that of the first discharge duct **409**. As can be appreciated, the second discharge duct **411** may not be needed if the second retractable fan **200'** is not provided. The second exhaust duct **411** delivers humidified air to a connection duct **413**. When the humidified air is exhausted to the connecting duct **413** through the second discharge duct **411**, the mixed humidified air travels to the second vertical duct **208'** of the second secondary space **24** for expelling of humified air by the second retractable fan **200'**. The connecting duct **413** extends through the rear space **13*s*** formed between a rear surface of the rear plate **13** and the wall surface. Dampers may be provided at the first discharge duct **409** and the second discharge duct **411** to control discharge of humidified air providing humidity to the living space through the first retractable fan **200** and/or second retractable fan **200'**.

A bucket seat **415** is installed on a bottom surface of the first inner space **203** to support the bucket **419** with a reservoir **429** and a tilting table **449** provided there between. A humidification pump **417** is installed adjacent to the bucket seat **415** to deliver the water supplied from the bucket **419** to the steam generator **407**. The tilting table **449** may allow tilting of the bucket **419** such that an upper end of the bucket **419** protrudes outward from the first inner space **203** to facilitate installation and removal of the bucket **419** into and from the first inner space **203**. See, e.g., FIG. **38**.

As shown in FIG. **27**, the bucket seat **415** may include a base **421** for mounting of the bucket seat **415** at the bottom of the first inner space **203** of the first inner frame **202**. A pair of guide columns **423** may be provided at a rear end (closer to the back plate **13**) of the base frame **421**. A pair of guide rails **425** forming a guide slot **427** is provided in a gap formed between the pair of guide columns **423**. The guide rails **425** may be integrally formed on inner surfaces of the guide column **423** facing each other, and a space between the guide rails **425** may form the guide slot **427**. The guide rails **425** may have a curved shape of a predetermined radius of curvature.

A reservoir tank **429** may protrude from an upper surface of the base **421** and may include a temporary liquid bin **431** inside the reservoir tank **429** to temporarily store liquid supplied from the bucket **419**. An upper plate **433** is installed over the reservoir tank **429** over an upper surface of the water storage portion **429** of the base frame **421** and a seal is provided in a groove formed around an upper opening of the temporary liquid bin **431** between the reservoir tank and the upper plate **433** to prevent liquid leakage. As can be appreciated, the upper plate **433** may be integrally formed on the base frame **421**.

A pair of holes **435** may be provided through supporting walls **437** protruding from the upper plate **433**. The pair of holes **435** forms a rotational or pivoting axis for the tilting table **449**. The supporting wall **437** further adds rigidity to the upper plate **437** and the tilting table **449** to further support a weight of the liquid in the bucket **419**. The supporting walls **437** are formed symmetrically on opposite sides of a reservoir inlet formed by an opening on the upper plate. Further, a valve protrusion **443** may extend through the reservoir inlet to extend through a valve seal of the bucket **419** to allow liquid to flow into the temporary liquid bin **431** of the reservoir tank **429**. As can be appreciated, the pair of holes **435** may be formed at both sides of the reservoir tank **429**.

A tilt stopper **439** may extend from an end of the seating wall **437**. The tilt stopper **439** may comprise at least one angled wall having an incline lowered toward the front end (closer to the first movable panel **16**) of the reservoir plate **433**. The tilt stopper **439** may support the lower surface of the tilting table **449** when the tilting table **449** is tilted toward the front.

A pair of tilt brackets **445** may include shafts **447** protruding, e.g., inwards, and inserted into the holes **435**. The tilt brackets **445** may be configured to be attached to the tilting table **449** by, e.g., screws. Because the shafts **447** are rotatable within holes **435** and the tilt bracket is attached to the tilting table **449**, the shafts **447** and holes **435** function as a tilt or pivot axis for the tilting table **449**, and the tilting table **449** is configured to tilt relative to the base **421** from a horizontal position to a predetermined angled position, where the limit of the predetermined angled position is set by the tilt stopper **439**.

The driving force for the tilting the tilting table **449** is transmitted through a tilting rack gear **451**. As shown in FIG. **28**, the tilting rack gear **451** is provided at a rear end of the tilting table **449**. The tilting rack gear **451** is curved to have a predetermined radius of curvature. The tilting rack gear **451** is configured to interlock with the guide rail **425** of the base **421**. Rack teeth **453** are formed on an outer surface of the tilting rack gear **451**. The rack gear **453** is operated in engagement with an output gear **467**. An interlocking channel **455** is provided on both sides of the tilting rack gear **451**. The guide rail **425** of the base **421** is positioned in the interlocking channel **455** to guide the movement of the tilting rack gear **451**.

The tilting table **449** may include a reservoir cover **457** having a water supply hole **459**. A bellows type connection hose protruding from the bucket **419** may be inserted through the water supply hole **459** to the reservoir inlet **441**. Upon insertion, the valve protrusion **443** extends through the valve seal provided in the bellow type connection hose to allow liquid in the bucket **419** to flow temporary liquid bin **431** of the reservoir tank **431**.

The driving force for the operation of the tilting table **449** is provided by the tilting driving source **461** shown in FIGS. **26** and **29**. The tilting driving source **461** may be an electric motor. The tilting driving source **461** is installed at the rear of the base frame **421**. A tilting reducer **463** which decelerates and transmits the driving force of the tilting driving source **461** is connected to the output shaft of the tilting driving source **461**. The reducer housing **465** forms the appearance of the tilting reducer **463**, and a plurality of gears are installed in the reducer housing **465**. The last gear in the gear train of the tilting reducer **463** is the output gear **467**. The output gear **467** is engaged with the rack gear **453** of the tilting table **449**.

A proximity sensor **470** may be place on the front of the housing **10**. See FIG. **1**. The proximity sensor **470** detects an approach of a user who intends to replace or refill the bucket **419**. When the user approaches the proximity sensor **470**, the first movable panel **16** slides automatically to an open position to reveal the first inner space **203**, and the tilting table **9** may be automatically tilted so that the top of the bucket **419** protrudes from the first inner space **203**. See FIG. **38**. As can be appreciated, a manual or touch button may be used instead of the proximity sensor **470**, or any other means may be used in place of the proximity sensor **470** to recognize a user's intention to replace or refill the bucket **419**.

As shown in FIGS. **30A-30C** and **31**, the machine room **500** is formed at one side of the second inner frame **202'**. The machine room **500** may comprise a remaining space other the second vertical duct **208'** formed by the second space frame **202'**. The upper compartment plate **501** form a ceiling of the machine room **500** and may be located at a position which is a first predetermined distance from the upper plate **14** of the housing **10**. The lower compartment plate **501'** may form a bottom of the machine room **500** and may be located at a position which is a predetermined second distance above the bottom plate **11** of the housing **10**. A second connection duct **204'** forming the second connection passage **205'** to the second vertical duct **208'** is provided below the lower compartment plate **501**. The air flow from the branch air flow passage **129** (provided on the right side) may be controlled by another damper (not shown), similar to the first damper **206** for the air flow to the first vertical duct **208**. Further, the controller **600** is provided in the machine room **500** for easy access and service if needed in the future.

A drain pump **502** may be installed on the bottom of the lower compartment plate **501'**. The drain pump **502** may be situated at a lower position than a bottom of the drain pan **108**. A connection hose **504**, e.g., a pipe or a tube, may connect the drain pump with the drain pan **108**. Based on the lower position, the connection hose **504** transfers the condensed water to the drain pump **502** by gravity. The connection hose **504** may penetrate a side surface of the drain pan **108**. The bottom surface of the drain pan **108** and a corresponding inner surface of the connection hose **504** may be aligned. As can be appreciated, the connection hose **504** may be connected to penetrate a bottom of the drain pan **108**. The drain pan **108** may be inclined such that the bottom surface of the drain pan **108** is tilted toward a side connected to the connection hose **504**.

The connection hose **504** may be divided into an upper end **505**, a connection section **505'** and a lower end **505"**. The upper end **505** is connected to the drain pan **108** and the lower end **505"** is connected to the drain pump **502**. The lower end **505"** is located at the lowest position of the connecting hose **504**, and a predetermined height difference exists between the upper and lower ends **505**, **505"**. The connection section **505'** is provided where the height difference exists between the upper and lower ends **505**, **505"**.

A discharge hose **506**, e.g., a pipe or a tube, is connected to the drain pump **502**. The discharge hose **506** serves to transfer the condensed water pumped through the connection hose **504** and to the outside through the discharge hose. The discharge hose **506** extends through a hole **13'***b* of the rear plate **13** to the outside. A minimum height H of the discharge hose **506** is at least 400 mm, and a maximum height H of the discharge hose **506** of the hose through a first hole **13'***b* of the rear plate **13** may be an uppermost end of the rear plate **13**.

The machine room **500** has a gas supply hose **510**, e.g., a pipe or a tube, provided through a second hole **13'**a of the back plate **13**. The gas supply hose **510** may be used to supply air containing a higher concentration of oxygen and/or anion (compared to the ambient air) to the air passage **102**. The supply of higher concentration of oxygen and/or anion may create a healthier living environment. The supply hose **510** may penetrate through the back plate **13**, e.g., the second hole **13'***a*, the second inner space frame **202'** and the second partition plate **19'** such that the main air passage **102** may be configured to receive an additional air supply provided via an external source, e.g., an oxygen tank and/or an anion generator or an air ioniser. Depending on the size, the anion generator may be provided inside of the main air passage **102** while the oxygen tank is coupled to the gas supply hose **501**.

As shown in FIG. **30**D, the second inner frame **202'**, which is provided inside the second secondary space **24**, provides the second inner space for the machine room **500**, the second vertical duct **208'**, the upper compartment plate **501**, and the lower compartment plate **501'**. The second inner frame **202'** includes holes **202'***a*, **202'***b*, **202'***c*, **202'***d* and **202'***e* aligning with the power supply hole **26**, through hole **29**, a first hole **13'***a*, a second hole **13'***b*, and through hole **13"**, respectively. Further, the second inner frame **202'** may include additional holes or openings for the third hole **13'***c* and the second connection duct **204'**.

As shown in FIGS. **32** and **33** of the air management apparatus or device, ambient air or indoor air is drawn through the bottom inlet **11'** by turning on at least one of the primary impellers **130**, **130'**, **130"**. The air passes through the replaceable filter **300** for removal of dust, foreign substances, and odors. The air suctioned through the bottom inlet **11'** is directed to flows to the rear end of the air passage **102** by the inlet guide **110**. Because of the angled guide surface **11'** of the air inlet guide **110** being inclined upward toward the rear plate **13**, i.e., the space between the angled guide surface **110'** and the replaceable filter **300** becomes wider toward the rear plate **13**, air passing through the replaceable filter **300** is mainly guided toward the rear plate **13**.

Air flowing to the rear end of the main air flow passage **102** near the rear plate **13** is directed to enter the primary impeller openings **124**, **124'** and **124"** by the operation and suction force of the primary impellers **131**, **131'** and **131"**. Prior to entering the primary impeller openings **124**, **124'**, **124"**, the air drawn into the main air flow passage **102** is heat-exchanged while passing through the heat exchanger **104**. The upper guide **112** guides the air flowing in the air flow path **102** so that air is transferred or directed to the heat exchanger **104**. The upper guide **112** may allow all of the air flowing in the main air flow path **102** to pass through the heat exchanger **104** while preventing the air from flowing over the top of the heat exchanger **104**.

Based to the number of primary impeller openings and/or the number of primary impellers being driven, the air flow path may be separated. For example, if all three primary impellers **131**, **131'**, **131"** are driven, the heat exchanged air enters corresponding primary impeller openings **124**, **124'**, **124"**. The heat exchanged air is drawn through the primary impeller inlet **126** and exhausted to the primary impeller outlet **128**. When the louvers **142**, **142**, **143** of the corresponding discharge ports **15'-1**, **15'-2**, **15'-3** are opened to be at a predetermined angle, heat exchanged air exhausted through the primary impeller outlet **128** is guided by the louvers **141**, **142**, **143** and discharged into the indoor space.

In the present embodiment, the air or heat exchanged air may be discharged through the discharge ports **15'-1**, **15'-2** and **15'-3** based on the operation of the primary impellers **131**, **131'**and **130"**. The discharge of the air through the discharge ports **15'-1**, **15'-2**, **15'-3** may be independently set according to whether the specific primary impellers **130**, **130'**, **130"** are turned ON. For example, when only the first primary impeller **130** is turned ON while second and third primary impellers **131'**,**131"** are turned OFF, the first louver **141** may be opened at a predetermined to discharge the heat-exchanged air or air is dispersed only through the first discharge port **15'-1**. When only the second primary impeller **131'** is turned ON, the second louver **142** may be opened at a predetermined angle to discharge the air, e.g., heat exchanged air, only through the second discharge port **15'-2**. Similarly, when only the third primary impeller **131"** is turned ON, the third louver **143** may be opened at a predetermined angle to disperse the air only through the third discharge port **15'-3**. However, as can be appreciated, the operation of the primary impellers **131**, **131'** and/or **131"** may be combined to disperse the air through a combination of corresponding discharge ports **15'-1**, **15'-2**, **15'-3**.

Further, the distance of the air dispersed through the discharge port **15'-1**, **15'-2**, **15'-3** may be independently controlled by varying the rotational or pivot angle of the louvers **141**, **142**, **143**. As such, the air management or air dispersal may be performed and combined at the front region of the housing **10** according to the operation of the primary impellers **131**, **131'**, **131"** and the rotation angles of the louvers **141**, **142**, **143**. Referring to an example in which the air management device is operated in the present embodiment, three users sitting or standing in front of the housing **10** in a position corresponding to each of the discharge ports **15'-1**, **15'-2**, **15'-3**, the operation of turning OFF and ON and rotational speed of the primary impellers **131**, **131'**, **131"**) and the rotation angle of the louvers **141**, **142**, **143** may be controlled according to each user based on individual needs to manage the air. In the example shown in FIG. **33**, the first damper **206** on the left side and corresponding damper on the right side may be closed to prevent air, e.g., heat exchanged air, from being diverted to the retractable first and second fans **200**, **200'** through the branch air flow channel, e.g., **129**, where air may directed to the retractable first duct or first pop-up duct **234** and/or retractable second duct or second pop-up duct **234'**.

The opening and angle adjustment of the louvers **141**, **142**, and **143** are performed by driving the louvre motors **141'**, **142'**, and **143'**. The louvers **141**, **142**, **143** are rotated to an angled opened position when pivot brackets **145** connected to the output shafts of the louver motors **141'**, **142'**, **143'** are rotated. The output shafts of the louver motors **141'**, **142'**, **143'** may be operated by setting a speed and a torque by a reduction gear therein. The rotation angles of the louvers **141**, **142**, and **143** may be set by the degree of rotation of the output shafts of the louver motors **141'**, **142'**, **143'**.

The rotation or pivot angles of the louvers **141**, **142**, **143** may be selected by the user selecting a corresponding operation mode from a plurality of preset operation modes. Through this operation, air, e.g., heat exchanged air, discharged through the discharge ports **15'-1**, **15'-2**, and **15'-3** may be directly delivered to a specific user or indirectly. For example, when the heat-exchanged air is discharged in the forward direction of the discharge ports **15'-1**, **15'-2**, and/or **15'-3**, the air may be directly delivered to the user in front of the housing **10** when the rotation angle of the louvers **141**, **142**, **143** is ninety (90) degrees from a vertical axis. Alternatively, by adjusting the rotation angle of the louvers **141**, **142**, **143** to be less than 90 degrees, air discharged from the discharge port **15'-1**, **15'-2**, and/or **15'-3** may be indirectly dispersed to the user. As can be appreciated, the rotation angle louvers **141**, **142**, **143** may not be fixed to a single angle. Instead, the rotation angle may change between two different angles to disperse the air into the livable space.

As shown in FIGS. **34-35**, the retractable first and second fans **200** may be operated to disperse air further and/or wider than using only the discharge port **15'-1**, **15'-2**, **15'-3**. The retractable first and/or duct **234**, **234'** may protrude above the upper surface of the housing **10** and rotate to disperse air to a further and/or wider area including a space adjacent to the space in which the air management device is installed. For example, if the air management device of the embodiment is used in the living room, the air coming out through the retractable first and/or second fan(s) **200**, **200'** may disperse the air to the adjacent kitchen.

In order for air to be discharged or dispersed to the surrounding space through the discharge vents **242** of the retractable first duct **234**, air may be supplied to through the branch air flow passage **129**. The first damper **206** may be opened to allow the branch air flow passage **129** and the first connection duct **204** communicate with each other. When at least one of the first primary impeller **131** or the third primary impeller **131"** is turned on, the heat-exchanged air may be discharged through the discharge vents **242** of at least one of first or second retractable fans **200**, **200'** protruding above the top surface of the housing **10**. Although the second louver **142** of the second discharge port **15'-2** is opened when the second primary impeller **131'** is turned on, the second louver **142** may be closed similar to first louver **141** and third louver **143** and the second primary impeller **131'** turned off while at least one of the first or third primary impeller **131**, **131"** turn on such that air is discharged or dispersed only through the first and second retractable fans **200**, **200'**.

FIG. **34** illustrates the air flow through the first retractable fan **200** on the left side of the housing **10**. When the first primary impeller **130** is driven to be ON and the first damper **206** is opened, the air exchanged in the heat exchanger **104** flows to the branch air flow passage **129**. Air flowing into the branch air flow passage **129** passes through the opened first damper **206** to the first connection passage **205** of the first connection duct **204**. The first connection passage **205** is in communication with the first vertical flow path **210** of the first vertical duct **208**, so that the air passing through the first connection passage **205** flows to the first vertical flow path **210**.

In order to discharge the air through the discharge vents **242** of the first retractable duct **234**, the first retractable fan **200** is raised above the upper surface of the housing **10**. As previously described, the retractable first duct **234** is supported on a first lift platform **214**, and when the lift motor **230** is turned ON, the second lift gear **232** rotates along the first lift gear **212** to raise the lift platform **214** with the retractable first duct **234**, as shown in FIG. **35** in the direction of the arrow A. See also FIGS. **13**, **15** and **16**.

The first retractable fan **200** may also rotate in the direction of the arrow B shown in FIG. **35**. For rotation, the rotary motor **226** installed in the lift platform **214** may be turned ON. When the rotary motor **226** is driven, the retractable first duct **234** rotates in conjunction with the second rotary gear **240** formed on the first support base **238** of the retractable first duct **234** while the first rotary gear **228** rotates. By rotating the retractable first duct **234** in a protruding state, the heat-exchanged air may be sent to a desired position by the user.

The discharge vents **242** may formed in an area of less than half of the retractable first duct **234** when viewed from the front. Although the retractable first duct **234** may rotate 360 degrees, the rear surface of the housing **10** is installed adjacent to the wall of the living space, and the retractable first duct **234** may substantially discharge air over a rotational region of about 180 degrees. For example, when the user is in front of the discharge ports **15'-1**, **15'-2**, **15'-3**, the user may rotate the first retractable fan**200** such that discharge vents **242** are directed in the user direction to discharge air to the users. In other words, the air may be discharged to a particular by rotating the retractable fan **200** such that the discharge vents **242** face the corresponding space desired by the user.

Alternatively, the retractable first duct **234** may discharge the air while rotating the retractable first duct **234** by continuously reciprocating between predetermined angle ranges from side to side. Alternatively, or in addition thereof, the first directional blades **244** may adjust air dispersal in a vertical direction as the air exits through discharge vents **242**. By adjusting the longitudinal or lateral direction of air dispersion, the direction of the heat exchanged air may be adjusted. Further when the air is discharged through the discharge vents **242** of the first retractable duct **234**, the first secondary impeller blades **224** may be selectively rotated. The rotation of the first secondary impeller blades **224** pressurizes the air in the first communication passage **218** to send the air discharged through the retractable first duct **234** farther.

As can be appreciated similar to selective operation of the retractable first and/or second fans **200**, **200'**, the first to third discharge ports **15'-1**, **15'-2** and **15'-3** may be selectively opened or closed based on the operation of the first to third primary impellers **131**, **131'**, **131"**. For example, when more users are situated in front of the housing **10**, air dispersion of heat exchanged air may be manage air on different conditions and locations at the same time. In FIG. **35**, the first and third louvers **141** and **143** are shown in a closed position, but may be selectively opened to allow air to discharge through them depending on the number of users or location for air dispersal.

As previously described, the replaceable filter **300** filters the air. The air delivered to the bottom inlet **11'** passes directly through the first filter **320**. Since the first filter **320**, the second filter **330**, and the third filter **340** are sequentially stacked on the filter frame **301**, filtered air further filtered through the second filter **330** and the third filter **340** to further remove dust, fine dust, and odors are removed. Thereafter, air passing through the replaceable filter **300** enters the main air flow passage **102**.

After extended and/or continuous filtering based on the operation of the air management device in the livable space, dust and odor components may be collected by the replaceable filter **300**. The filter cleaner **370** is operated to maintain the performance of the replaceable filter **300** above a certain level of performance. The filter cleaner **370** is installed at one side of the bottom surface of the bottom plate **11**, which is an area outside the bottom inlet **11'**, and moves along the cleaner rail **380** upon receiving an operation signal from the controller **600**.

As the filter cleaner **370** passes through the bottom inlet **11'**, dust and foreign matter are sucked through the cleaner suction port **373**, e.g., dust and foreign matter in the first filter **320** enter the cleaner suction port **373** by the suction force of the cleaner **370**. Based on the filter cleaner operation, the performance of replaceable filter **300**, e.g., the first filter **320**, may be improved.

As previously discussed, the filter cleaner **370** has a predetermined weight and may sag on the cleaner rail **380** due to gravity. For example, the filter cleaner may sag at the middle of the cleaner rail, which may correspond to the farthest location from the ends of the cleaner rail **380** mounted to the bottom plate **11** of the housing, the elastic deflection of the elastic bristles **375** around the cleaner suction port **373** provide continuous contact with the bottom inlet **11'** to prevent loss of suction force. Even if the distance between the surface of the first filter **320** and the filter cleaner **370** changes, the degree of elastic deflection of the elastic bristles **375** may change to allow continuous contact between the first filter **320** and the filter cleaner **370**. The filter cleaner **370** performs the cleaning on the first filter **320** while linearly reciprocating along the cleaner rail **380**. When the cleaning of the first filter **320** is completed, the filter cleaner **370** rest on the bottom surface of the bottom plate **11**, e.g., at an end of the cleaner rail **380**, to prevent impediment of the bottom inlet **11'**.

After extended use or cleaning of the replaceable filter **300** is insufficient, the first, second and third filters **320**, **330**, and **340** in the filter frame **301** may be removed from the housing **10** for replacement. When the user grasps and pulls the handle **303'**, the filter frame **301** may be pulled out of the housing **10** like a drawer. The rail assembly **350** is assists in withdrawal of the filter frame **301** from the front of the housing **10**, as illustrated in in FIG. **36**. When the filter frame **301** is withdrawn from the front of the housing **10**, the support rib **313** at the rear end of the filter frame **301** is hooked inside the bottom entry for the filter frame **301** at the bottom of the front plate **15** of the housing **10** to support the rear end of the filter frame **301** and to prevent the front end of filter frame **301** from falling. Further, the rail assembly **350** couples the filter frame **301** to the housing **10** to the filter frame **301** from falling out arbitrarily.

In this state, the second filter **330** and the third filter **340** in the storage space **325** are simultaneously removed from the filter frame **301** together with the first filter **320** when the storage case **324** is lifted out of the filter frame **301**. The filters **320**, **330**, and **340** in the three pass openings **302** may be all be pulled out to perform maintenance or replacement. After maintenance or replacement with new filters, the storage case **324** with filters **320**, **330**, and **340** may be placed back into the plurality of passage openings **302** of the filter frame **301**. For example, the second filter **330** and the third filter **340** are sequentially stacked in the storage space **325** of the storage case **324** and are positioned in the passage openings **302**, and thereafter, the filter frame **301** is pushed or slide back into the housing **10**.

Humidification may be added to the air being discharged through the first and/or second retractable ducts **234**, **234'** in two scenarios. In the first scenario, humidification of the air may be possible without the heat exchange through the heat exchanger **104**, i.e., humidification and filtering of the ambient air. In the second scenario, humidification of the air may be possible for all heating modes of operation.

In the first scenario, the inlet fan **403** is operated to suck air in from the main air flow passage **102** through the inlet duct **401**. The air pressurized by the inlet fan **403** is sent to the steam generator **407** through the transfer duct **405**. In the steam generator **407**, the liquid steam/vapors made by heating the liquid delivered from the bucket **419** is mixed with the air. The humidified air may be delivered through at least one of the first discharge duct **409** or the second discharge duct **411** to at least one of the first retractable duct **234** or the second retractable duct **234'**, respectively.

FIG. **37** illustrates the delivery of the humidified air to the retractable first duct **234** on the left side of the housing **10** by opening the first discharge duct **409** to the first connection passage **205** of the first connection duct **204**. The first damper **206** may be closed and the first primary impeller **130** may be turned OFF. Optionally, if the heat exchanger is maintained in an OFF state, the first damper **206** may be opened and the first primary impeller **130** may be turned ON to allow an air flow through the branch air flow passage **129**. The humidified air from the first discharge duct **409** passes through the first connection passage **205** and the first vertical flow path **210** to the retractable channel **236** of the first retractable duct **234**. The humidified air is discharged through the discharge vents **242** of the first retractable fan **200** protruding above the upper surface of the housing. The first retractable duct **234** may be rotated to disperse the humidified air to a farther and wider area. Further, the first secondary impeller blades **224** may be driven to pressurize the humidified air to be discharged farther.

In the second scenario, humidification may be additionally performed for during heating or cooling operation of the HVAC system **100**. In such a case, heat exchange is performed in the heat exchanger **104**, and the heat-exchanged air is dispersed through at least one of the discharge ports **15'-1**, **15'-2**, **15'-3**. While being discharged therethrough, the humidified air may be simultaneously discharged through the first connection passage **205**, the first vertical flow **210**, the retractable channel **236** in order to be discharged into the indoor space, similar to the first scenario.

As can be appreciated, liquid, e.g., water or mixture with solvent, is required for humidification, and may be stored and suppled from the bucket **419**. As previously described the bucket **419** is seated on the bucket seat **415** in the first inner space **203**. As shown in FIG. **38**, when the proximity sensor **470** recognizes the user, the first movable panel **16** slides to the left side, and the tilting table **449** of the bucket seat **415** is operated to be inclined downward toward the front of the housing **10**. The inclined position of the bucket **219** assists the user to readily remove and replace the bucket **419** from the first inner space **203**. After removal and/or replacement of the bucket **219**, the proximity sensor **470** operation instigates the return of the tilting table **449** to a horizontal position, and the first movable panel **16** closes the first inner space **203**.

FIGS. **39** and **40** illustrates the operation of the tilting table **449**. See also FIGS. **26-28**. When the tilting table **449** is rotated, the tilting table **449** is rotated about the shaft **447** with respect to the base **421**. The force for the rotation of the tilting table **449** is provided by the motor **461**, and the tilting reducer **463** operates the gear train. As the output gear **467** of the tilting reducer **463** is rotated in engagement with the rack teeth **453**, the tilting rack gear **451** moves along the guide rail **425** of the base **421**. Because the guide rail **425** is positioned in the interlocking channel **455** of the tilting rack gear **451** and guides the tilting rack gear **451** to be moved by the output gear **467**, the tilting table **449** is rotated about the shaft **447**.

As the tilting table **449** rotates about the shaft **447**, the tilting table **449** may be selectively positioned between the horizontal state and the inclined state. Because the bucket **419** is positioned on the tilting table **449**, the bucket **419** is in an inclined state when the first movable panel **16** is opened, and the bucket **419** is in an horizontal state when the first movable panel **16** is closed. When the bucket **419** seated on the tilting table **449**, the valve in the bucket **419** is opened by the valve protrusion **443** so that liquid may be delivered to the temporary liquid bin **431**. The liquid in the temporary liquid bin **431** may be delivered to the steam generator **407** by the humidification pump **417** to be heated and vaporized.

When the working fluid and air exchange heat in the heat exchanger **104**, moisture in the air may condense and water may form on the surface of the heat exchanger (**104**). As the size or the quantity of the condensate formed on the heat exchanger **104** increases, the condensed water may flow down the surface of the heat exchanger **104** and collect in the drain pan **108**, as illustrated in FIG. **41**. The condensed water collected in the drain pan **108** may flow by gravity into the connection hose **504**. When condensed water is delivered to the drain pump **502** through the connection hose **504**, the drain pump **502** operates to pressurize the condensed water. The pressurized water is pumped along the interior of the discharge hose **506**. The condensate flowing along the discharge hose **506** may be pressurized and moved up to the maximum height H of the discharge hose **506**. After the condensed water is delivered to the maximum height H of the discharge hose **506**, the condensed water may be discharged by gravity action thereafter.

Because the connection hose **504** has a lower end **505"** connected to the drain pump **502** and the upper end **505** connected to the drain pan **108** and the drain pan **108** is inclined toward the connection hose **504**, the condensate collected at the drain pan **108** naturally flows down the connection hose **504** by gravity and fed to the drain pump **502**. Hence, the condensate on the drain pan **108** is naturally fed by gravity to first fill the connection hose **504**, and after the connection hose **504** is filled, the drain pan **108** starts collecting the condensate.

After the drain pan **108** has collected a predetermined amount of condensate or after a predetermined time period of operating the heat exchanger **104**, the drain pump **502** is operated or turned ON. For example, a sensing means may be provided in the drain pan **108** to determine the predetermined amount of condensate, or a timer may be started by the controller to start the operation of the drain pump **502**. If the condensed water stagnates too long in the drain pan **108**, there may be a hygiene problem, such as bacteria propagation, and it may beneficial to minimize the time that the condensed water pools in the drain pan **108**, the air to the drain pump **502**.

In order to minimize suction power and prevent damage to the drain pump **502**, the operation of the drain pump **502** may be stopped in the state where water may remain at the lower end **505"** of the connection hose **504**. As shown in FIG. **41**, the operation of the drain pump **502** may be stopped at the water level A indicated by arrow A. The position indicated by arrow A may correspond to the minimum level of condensate inside the connection hose **504**. The highest water level in the connection hose **504** may be the upper position of the connection section **505'**.

FIG. **42** illustrates a schematic diagram of an air management apparatus, and FIG. **43** illustrates a flowchart of a control method for the air management apparatus. FIGS. **44** and **45** illustrate flowcharts of the control methods according to another embodiments.

As illustrated in FIGS. **42** and **43**, the input unit **17** may be configured to receive a user's manipulation provided on the front surface of the housing **10**. The user may input and set an operation of the air management device through the manipulation of the input unit **17**. The user may directly touch the input unit **17** or may input the user operation through a wireless communication with an external device. Upon determination of a valid user operation through the input unit **17**, the control unit **600** starts an operation for air discharge from the air management apparatus. [S**101**: User Operation Input step].

The controller **600** drives at least one of the primary impeller motors **132**, **132'** and/or **132"** upon a valid user operation through the input unit **17**. [S**103**: Primary Impeller Motor Driving Step]. Upon activation of the primary impeller motor(s), at least one of the primary impeller blades **130**, **130'** and/or **130"** of the primary impellers **131**, **131'** and **131"** installed in the primary impeller guide **120** rotates to create a suctioning force. [S**105**: Primary Impeller Operation Step]. The air outside of the air management system is sucked through the bottom inlet **11'** and introduced into the primary air flow space **20** therein. [S**107**: Air Suction Step].

When air flows into the primary air flow space **20** through the bottom inlet **11'**, heat exchange proceeds in the heat exchanger **104** provided inside the housing **10**. To this end, the control unit **600** drives the heat exchanger **104**. Specifically, the air passing through the bottom inlet **11'** flows through the primary air flow path **102** to exchange heat with the heat exchanger **104**. [S**109**: Heat Exchange Step]. At least one of the primary impellers **131**, **131'** and/or **131"** continue to operate to suction the air in the primary air flow passage **102** through the heat exchanger **104** to deliver the heat exchanged air to at least one of the discharge ports **15'-1**, **15'-2**, and/or **15'-3** provided on the front plate **15** of housing. [S**111**: Air Supply Step to Discharge Port]. In order to discharges the air provided to the at least one discharge ports **15'-1**, **15'-2** and/or **15'-3** to the outside, the corresponding louvers **141**, **142** and **143**, which are separately driven by louver motors **141'**, **142'** and **143'**, must be opened. [S**113**: Louver Opening Step].

As previously described, the heat exchanged air may be supplied to the at least one of the first retractable fan **200** through the branch air flow passage **129** in the first primary impeller opening **124** or the second retractable fan **200'** through another corresponding branch air flow passage in the third primary impeller opening **124"**. For example, the branch air flow passage **129** may transfer the heat-exchanged air to the first retractable fan **200**. The first retractable fan **200** allows the pop-up duct **234** to protrude from the upper surface of the housing **10** to disperse the heat exchanged air farther and wider.

If the first or the second retractable fan **200** or **200'** is not used, the controller **600** closes the first damper **206** to prevent passage of air through the branch air flow passage [S**115**: Damper Closing Step], and the heat-exchanged air is discharged through at least one of the plurality of discharge ports **15'-1**, **15'-2**, **15'-3** with at least one of the louvers **141**, **142**, **143** opened to the front of the housing **10**. [S**117**: Air Discharge Step]. Further, the angle of the louvers **141**, **142**, **143** may be adjusted by the controller **600** based on the current supplied to the louver motors **141'**, **142'** and **143'**.

FIG. **44** in conjunction with FIG. **42** illustrate an additional control method of the air management apparatus for discharging the heat exchanged through at least one of the first retractable fan **200** or the second retractable fan **200'** without air discharge through the discharge ports **15'-1**, **15'-2** and **15'-3**. Steps S**201** to S**209** of FIG. **44** may be the same or similar Steps S**101** to S**109** of FIG. **43**, and hence, the description is omitted. For purpose of illustration, the following description pertains to discharge of air through the first retractable fan **200**.

In Step S**211** [S**211**: Louver Closure Step], the louvers **141**, **142**, and **143** are closed to prevent air from being discharged through the discharge ports **15'-1**, **15'-2**, and **15'-3**. The control unit **600** simultaneously or sequentially opens the first damper **206** to supply air to the first retractable fan **200** through the branch air flow passage **129**. [S**213**: First Damper Opening Step]. As such, the heat exchanged air is supplied to the branch air flow path **129**. [S**215**: Branch Air Flow Step]. Consequentially, the air through the branch air flow passage**129** is supplied to the first retractable fan **200**. [S**217**: Air supply Step for Additional Discharge]. The first retractable fan **200** protruding above one side of the upper surface of the housing **10** discharges the heat exchanged air to the outside. [S**219**: Air Discharge Step].

FIG. **45** in conjunction with FIG. **42** illustrate an additional control method of the air management apparatus for discharging the heat exchanged through at least one of the first retractable fan **200** or the second retractable fan **200'**, which may be rotated. For purpose of illustration, the following description pertains to discharge of air through the first retractable fan **200**.

A user may input a user operation for lifting and rotating the first retractable fan **200** through the input unit **17**. [S**301**: User Operation Input Step]. When the user's manipulation according to the operation of the first retractable fan **200** is received, the control unit **600** drives the lift motor **230** for the first retractable fan **200** to protrude above the upper surface of the housing **10**. [S**303**: Lift Motor Driving Step]. By the driving of the lift motor **230**, the first retractable fan **200** is raised to protrude to the upper surface of the housing (**10**). [S**305**: Raising of the Fan **200** step].

The controller **600** may drive a motor to rotate the first secondary impeller blade **224** to pressurize the air discharged through the first retractable fan **200**. The first secondary impeller blade **224** pressurizes the air in the first communication passage **218** received through the branch air flow passage **219** to send the air farther. [S**307**: Rotate Secondary Impeller Blade Step]. The air heat exchanged by the heat exchanger **104** is discharged through the discharge vents **242**. [S**309**: Air Discharge Step].

The first retractable fan **200** may be rotated at a predetermined angle. A user may input a user manipulation for the rotation of the first retractable fan **200** through the input unit **17**. If it is determined that the user operation for the rotation of the additional retractable fan **200** is input through the input unit **17**, the controller **600** controls the operation of the first retractable fan **200** in the air management apparatus. [S**311**: User Operation Input Step].

The control unit **600** may drive a rotary motor **226** that provides a rotational force to the first retractable fan **200**. [S**313**: Rotary Motor Drive Step]. The first retractable fan **200** may be rotated by the rotation motor **226**. As the first retractable fan **200** rotates, the air heat-exchanged in the heat exchanger **104** may be discharged to the outside. [S**315**: Rotational Air Discharge Step].

FIG. **46** in conjunction with FIG. **42** illustrate an additional control method of the air management apparatus for discharging the humidified air through at least one of the first retractable fan **200** or second retractable fan **200'** with the heat exchanger **104** turned off. A user may input and set an operation for added humidity to the surrounding through the manipulation of the input unit **17**. The user may directly touch the input unit **17**, or may input the user operation through wireless communication with an external device. If user operation is determined to be valid, the controller **600** starts the operation control for humidification in the air management apparatus [S**401**: User Operation Input Step].

The controller **600** initiates the humidification process by raising at least one of the first retractable fan **200** or the second retractable fan **200'** to protrude above the upper surface of the housing **10**. For example, the controller initiates the operation of the lift motor **230** installed in the first lift platform **214**. The rotation of the second lift gear **232** coupled to the shaft of the lift motor **230** and engaged with the first lift gear **212** vertically raises the first lift platform **214**. As a result, the first retractable duct **234** coupled to the first support ring **216** of the first lift platform vertically rises with the first lift platform **214**. [S**403**: Retractable Fan Rising Step].

Optionally, or in addition, the controller **600** may drive the first primary impeller **131** and may drive the second impeller **131'** and/or third impeller **131"** to supply the indoor air to the inside through the bottom inlet **11'**. If the heat exchanger **104** is turned OFF, and the corresponding louvers **141**, **142**, and/or **143** may be opened to allow discharge of air [S**405**: Optional Primary Impeller and Louver Operation Step]. If the corresponding primary impeller or impellers is operated, air is sucked from the outside into the housing **10** through the bottom inlet **11'** to flow into the main air flow passage **102**. [S**407**: Optional Air Intake Step]. Further, the controller may open the corresponding dampers to allow passage of air from the branch air flow passage **129** at least one of the first retractable fan **200** or the second retractable fan **200'**. [S**409**: Optional Brach Flow Air Passage Step].

If the optional steps S**405** to S**409** is not desired based on the user input in step S**401**, the process may go immediately from step S**403** to step S**411**. [S**411**: Humidity Generation Step]. The air from the main air flow passage pressurized by the inlet fan **403** and sent to the steam generator **407** through the air transfer duct **405**. The humidification pump **417** supplies water from the bucket **419** to the steam generator **407** under control of the controller **600**, and the steam generator **407** produces steam from the liquid transferred from the bucket **419**. The generated steam is mixed with the air delivered through the transfer duct **405**.

The humidified air may be delivered to at least one of the first retractable duct **234** or the second retractable duct **234'** through at least one of the first discharge duct **409** or the second discharge duct **411** based on opening or closing of dampers. [S**413**: Humidity Delivery to the Retractable Fan Step]. For example, when the humidified air is discharged through the first retractable duct **234** on the left side of the housing **10**, the damper for the first discharge duct **409** is opened for connection or communication the first connection passage **205** of the first connection duct **204**. The first damper **206** may be closed to cut off communication with between the branch air flow passage **219** and the first connection duct **204** to prevent mixing of air and humidified air causing formation of condensation or moisture in the first connection duct **204**.

If a user selects rotation of the first retractable fan **200** through the input unit **17**, the controller **600** initiates the rotation of the first retractable fan **200**. [S**415**: User Operation Input]. As can be appreciated, such an input may be previously provided through step S**401**. Based on the rotary motor **226** being driven, the first retractable fan **200** rotates to further disperse the humidified air. [S**417**: Rotation of Retractable Fan Step].

FIG. **47** in conjunction with FIG. **42** illustrate an additional control method of the air management apparatus for discharging the humidified air through at least one of the first retractable fan **200** or second retractable fan **200'** with the heat exchanger **104** turned ON for simultaneously performing the air temperature setting and humidification.

The user may input a user operation for air temperature setting and humidification through the input unit **17** formed on the front surface of the housing **10** of the air management device. The user may directly input the user operation by directly touching the input unit **17** or may input the user operation through wireless communication with an external device. [S**501**: User Operation Input Step].

If it is determined that a valid user operation is input through the input unit **17**, the controller **600** may start the operation of the air management device by starting the operation of at least one of the primary impellers **131**, **131'**, **131"** to rotate at least one of the primary impeller blades **130**, **130'** and **130"**, respectively. [S**503**: Drive Fan Operation Step]. When at least one of the primary impellers **131**, **131'**, **131"** are operated, air surround the housing **10** is drawn through the bottom inlet **11'** and introduced into the main air flow passage **102**. [S**505**: Air Suction Step]. When the air flows into the main air flow passage **102** of the primary air flow space through the bottom inlet **11'**, heat exchange proceeds in the heat exchanger **104** disposed inside the housing **10**. To this end, the controller **600** drives the heat exchanger **104** to perform heat exchange. [S**507**: Heat Exchange Step].

The heat exchanged air of the heat exchanger **104** may be delivered to at least one of the discharge ports **15'-1**, **15'-2**, **15'-3** provided on the front plate **15** of the front plate **15** by the rotation of at least one of the primary impellers **130**, **130'**, **130"**. The discharge ports **15'-1**, **15'-2**, and **15'-3** serve to discharge the heat exchanged air to the livable space in which the housing **10** is located. [S**509**: Air Supply Step to Discharge Port]. Because the louvers **141**, **142**, **143** determine opening and closing of the outlets **15'-1**, **15'-2**, **15'-3**, the louvers **141**, **142**, **143** must be opened. [S**511**: Louver Opening Step].

The heat exchanged air as described above may be supplied to at least one of the first retractable fan **200** or the second retractable fan **200'** through the corresponding branch air flow passage. For example, if the user input selected discharge of air through the first retractable fan **200**, the branch air flow passage **129** allows heat exchange air to flow to first connection passage **205** of the first connection duct **204** by opening the first damper **206**. [S**513**: Branch Air Flow Step].

The inlet fan **403** of the humidifier **400** draws in air from the main air flow passage **102** to deliver the air to the steam generator **407** through the air transfer duct **405**. The steam generator **407** heats the liquid delivered from the bucket **419** to generate steam, and the steam is thus mixed with the air delivered through the air transfer duct **405**. [S**515**: Humidifying Air Generation Step].

At least one of the first retractable fan **200** or the second retractable fan **200'** may be raised to discharge humidified air or heat exchange air to the outside. For example, if the user selects on the first retractable fan **200** in step S501, the controller initiates the operation of the lift motor **230** installed in the first lift platform **214**. The rotation of the second lift gear **232** coupled to the shaft of the lift motor **230** and engaged with the first lift gear **212** vertically raises the first lift platform **214**. As a result, the first retractable duct **234** coupled to the first support ring **216** vertically rises with the first lift platform **214**. [S**517**: Retractable Fan Rising Step].

The humidified air is supplied to at least one of the first retractable fan **200** or the second retractable fan **200'** through at least one the first discharge duct **409** or the second discharge duct **411**. For example, if the user selection in Step S**501** indicates discharge of heat exchanged air through the second retractable fan **200'** and discharge of humidified air to the first retractable fan **200**, the first damper **206** may be closed while the first discharge duct **409** of the humidifier **400** is opened to allow passage of humified air to the first connection passage **205** such that the heat exchange air, especially cooled air, provided through the branch air flow passage **129** may not mix with the humidified air to form condensation of liquid in the first connection duct **204**. [S**519**: Delivery of Humidified Air to Selected Retractable Step].

If a user selects rotation of the first retractable fan **200** through the input unit **17**, the controller **600** initiates the rotation of the first retractable fan **200**. [S**521**: User Operation Input]. As can be appreciated, such an input may be previously provided through step S**501**. Based on the rotary motor **226** being driven, the first retractable fan **200** rotates to further disperse the humidified air. [S**523**: Rotation of Retractable Fan Step].

In the illustrated embodiment, three discharge ports **15'-1**, **15'-2**, and **15'-3** are disclosed, but any number may be possible with different sized opening. Further, there may be one-to-one correspondence between the number of discharge ports and number of louvers, variations are possible, e.g., two discharge ports with a single louver to open or close the discharge ports. Various configurations of discharge port opened/closed and first and second retractable fans protruding from the upper surface of the housing **10** are possible. For example, the louvers may be closed to deliver the heat exchange air only to at least one of the first retractable fan **200** or second retractable fan **200'** or air sent to the opened louvers and protruding retractable fan. In other words, due to the independent operation of the louvers and retractable fans, the configuration for discharging air may be independently controlled by the user.

In the illustrated embodiment, the branch air flow passage **129** is in communication with the first vertical duct **208** through the first connection duct **204**. However, the branch air flow passage **129** and the vertical duct **208** may be directly connected with the first damper **206** interposed therebetween. In the illustrated embodiment, in the position of the first vertical duct **208** in the first inner frame **202** is biased toward the end of the housing **10** relatively away from the primary air flow space **20**. However, if the position of the vertical duct **208** is adjacent to the primary air flow space **20**, the connection duct **204** may be omitted, and/or the first discharge duct **409** may be directly connected to the vertical duct **208**.

In the illustrated embodiment, the first movable panel **16** is described as being automatically opened and closed, but this may not be required. A user may directly open or close the first movable panel **16**. Further, the tilting table **449** of the bucket seat **415** may be tilted by pressing a button or manually tilted.

Further, the lift motor **230** may be installed at the top of the first vertical flow path **210**, and the first lift gear **212** may be formed in the vertical direction on the rear surface of the first retractable duct **234**.

Although three filters **320**, **330**, and **340** may be used, less than three filters may be used. In addition, although three passing regions **302** are formed in the filter frame **301**, the number may be less. The rail assembly **350** may assist moving the filter frame **301** in and out of the housing **10**, but the rail assembly **350** may not necessarily used, and the filter frame **301** may be pulled in and out without the rail assembly **350**.

In the illustrated embodiment, the suction force at the cleaner suction opening **373** may be prevented from being leaked using the elastic bristles **375**, but various leakage blocking members such as elastic seals are used.

It will be understood that when an element or layer is referred to as being "on" another element or layer, the element or layer can be directly on another element or layer or intervening elements or layers. In contrast, when an element is referred to as being "directly on" another element or layer, there are no intervening elements or layers present. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items.

It will be understood that, although the terms first, second, third, etc., may be used herein to describe various elements, components, regions, layers and/or sections, these elements, components, regions, layers and/or sections should not be limited by these terms. These terms are only used to distinguish one element, component, region, layer or section from another region, layer or section. Thus, a first element, component, region, layer or section could be termed a second element, component, region, layer or section without departing from the teachings of the present invention.

Spatially relative terms, such as "lower", "upper" and the like, may be used herein for ease of description to describe the relationship of one element or feature to another element(s) or feature(s) as illustrated in the figures. It will be understood that the spatially relative terms are intended to encompass different orientations of the device in use or operation, in addition to the orientation depicted in the figures. For example, if the device in the figures is turned over, elements described as "lower" relative to other elements or features would then be oriented "upper" relative to the other elements or features. Thus, the exemplary term "lower" can encompass both an orientation of above and below. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein interpreted accordingly.

The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. As used herein, the singular forms "a", "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprises" and/or "comprising," when used in this specification, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

Embodiments of the disclosure are described herein with reference to cross-section illustrations that are schematic illustrations of idealized embodiments (and intermediate structures) of the disclosure. As such, variations from the shapes of the illustrations as a result, for example, of manufacturing techniques and/or tolerances, are to be expected. Thus, embodiments of the disclosure should not be construed as limited to the particular shapes of regions illustrated herein but are to include deviations in shapes that result, for example, from manufacturing.

Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

Any reference in this specification to "one embodiment," "an embodiment," "example embodiment," etc., means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the invention. The appearances of such phrases in various places in the specification are not necessarily all referring to the same embodiment. Further, when a particular feature, structure, or characteristic is described in connection with any embodiment, it is submitted that it is within the purview of one skilled in the art to effect such feature, structure, or characteristic in connection with other ones of the embodiments.

Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this disclosure. More particularly, various variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

What is claimed is:

1. An air management device, comprising:

a housing defining a space therein and having at least one air inlet provided at the housing and at least one discharge port provided at a front of the housing;

at least one primary impeller provided inside the housing to create an air flow to flow through the space;

a heat exchanger provided in the housing and configured to exchange heat air of the air flow; and

at least one discharge unit provided inside the housing and having a pop-up duct configured to retract into the housing or to protrude upward through an opening provided on an upper surface of the housing to discharge one of air and heat exchange air from the air flow caused by the at least one primary impeller,

wherein the pop-up duct is accommodated in a vertical duct inside the housing, the vertical duct configured to receive the air flow formed by the at least one primary impeller, and the pop-up duct being rotatably supported by a lift platform,

wherein a first lift gear is provided vertically on the vertical duct and a lift motor having a second lift gear is provided on the lift platform, wherein when the lift motor is driven, the second lift gear rotates to raise the lift platform along the first lift gear such that the pop-up duct rises above the upper surface of the housing.

2. The air management device of claim **1**, wherein the pop-up duct includes discharge vents formed on an outer surface of the pop-up duct, an area occupied by the discharge vents is smaller than 180 degrees with respect to a center of the pop-up duct.

3. The air management device of claim **1**, wherein a rotary motor having a first rotary gear is provided on the lift platform, and the pop-up duct is support by a support base having a second rotary gear, wherein when the rotary motor is driven, the first rotary gear rotates to be guided along a rack of the second rotary gear such that the pop-up duct rotates about a center of the pop-up duct.

4. The air management device according to claim **3**, wherein a directional blade is installed inside the pop-up duct to direct an angle of air discharged through discharge vents.

5. The air management device of claim **4**, further comprising a secondary impeller for pressurizing the air discharged through the pop-up duct.

6. The air management device of claim **5**, wherein the secondary impeller is installed in a passage formed in the lift platform.

7. The air management device of claim **1**, wherein the housing includes a primary impeller guide provided between the heat exchanger and the at least one discharge port, the primary impeller guide having at least one opening to house the at least one primary impeller.

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